

**APPENDIX A: MULTI-RESOLUTION LAND
CHARACTERISTICS (MRLC) CONSORTIUM DATA
DESCRIPTION**

Land Cover Classes:

Water

- 11 Open Water
- 12 Perennial Ice/Snow

Developed

- 21 Low Intensity Residential
- 22 High Intensity Residential
- 23 Commercial/Industrial/Transportation

Barren

- 31 Bare Rock/Sand/Clay
- 32 Quarries/Strip Mines/Gravel Pits
- 33 Transitional

Vegetated; Natural Forested Upland

- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest

Shrubland

- 51 Shrubland

Non-natural Woody

- 61 Orchards/Vineyards/Other

Herbaceous Upland

- 71 Grasslands/Herbaceous

Herbaceous Planted/Cultivated

- 81 Pasture/Hay
- 82 Row Crops
- 83 Small Grains
- 84 Fallow
- 85 Urban/Recreational Grasses

Wetlands

- 91 Woody Wetlands
- 92 Emergent Herbaceous Wetlands

Land Cover Classification System Land Cover Class Definitions:

Water - All areas of open water or permanent ice/snow cover.

11. Open Water - areas of open water, generally with less than 25 percent or greater cover of water (per pixel).

12. Perennial Ice/Snow - All areas characterized by year-long cover of ice and/or snow.

Developed - areas characterized by high percentage (approximately 30 percent or greater) of constructed materials (e.g. asphalt, concrete, buildings, etc).

21. Low Intensity Residential - Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.

22. High Intensity Residential - Includes heavily built up urban centers where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80-100 percent of the cover.

23. Commercial/Industrial/Transportation - Includes infrastructure (e.g. roads, railroads, etc.) and all highways and all developed areas not classified as High Intensity Residential.

Barren - Areas characterized by bare rock, gravel, sand, silt, clay, or other earthen material, with little or no "green" vegetation present regardless of its inherent ability to support life. Vegetation, if present, is more widely spaced and scrubby than that in the "green" vegetated categories; lichen cover may be extensive.

31. Bare Rock/Sand/Clay - Perennially barren areas of bedrock, desert, pavement, scarps, talus, slides, volcanic material, glacial debris, and other accumulations of earthen material.

32. Quarries/Strip Mines/Gravel Pits - Areas of extractive mining activities with significant surface expression.

33. Transitional - Areas of sparse vegetative cover (less than 25 percent that are dynamically changing from one land cover to another, often because of land use activities. Examples include forest clearcuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g. fire, flood, etc.)

Forested Upland - Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); Tree canopy accounts for 25-100 percent of the cover.

41. Deciduous Forest - Areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.

42. Evergreen Forest - Areas characterized by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.

43. Mixed Forest - Areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.

Shrubland - Areas characterized by natural or semi-natural woody vegetation with aerial stems, generally less than 6 meters tall with individuals or clumps not touching to interlocking. Both evergreen and deciduous species of true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions are included.

51. Shrubland - Areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g. herbaceous or tree) is less than 25 percent and shrubs cover exceeds the cover of the other life forms.

Non-natural Woody - Areas dominated by non-natural woody vegetation; non-natural woody vegetative canopy accounts for 25-100 percent of the cover. The non-natural woody classification is subject to the availability of sufficient ancillary data to differentiate non-natural woody vegetation from natural woody vegetation.

61. Orchards/Vineyards/Other - Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.

Herbaceous Upland - Upland areas characterized by natural or semi- natural herbaceous vegetation; herbaceous vegetation accounts for 75-100 percent of the cover.

71. Grasslands/Herbaceous - Areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.

Planted/Cultivated - Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75-100 percent of the cover.

81. Pasture/Hay - Areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.

82. Row Crops - Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.

83. Small Grains - Areas used for the production of graminoid crops such as wheat, barley, oats, and rice

84. Fallow - Areas used for the production of crops that are temporarily barren or with sparse vegetative cover as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.

85. Urban/Recreational Grasses - Vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

Wetlands - Areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al.

91. Woody Wetlands - Areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water.

92. Emergent Herbaceous Wetlands - Areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and the soil or substrate is periodically saturated with or covered with water

**APPENDIX B: SUPPLEMENTAL DATA (AVAILABLE UPON
REQUEST FROM MONTANA DEQ)**

APPENDIX C: DEARBORN RIVER MACROINVERTEBRATE AND PERIPHYTON ANALYSIS

DEARBORN RIVER MACROINVERTEBRATE AND PERIPHYTON ANALYSIS

The following tables and figures provide additional detail for the macroinvertebrate and periphyton data collected in the Dearborn River watershed. Macroinvertebrate data were collected from five sites in the Dearborn River between 2000 and 2003, and five samples were collected during that time.

DEARBORN RIVER

Table C-1. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance and periphyton values for the Dearborn River.

Chart ID	Sample Site ID Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
DB-1	M12DBRNR05 Dearborn blw. Falls	Macroinvertebrates						
		%tolerant taxa					0.3	
		no. EPT taxa					19	
		%clingers					63.7	
		no. clinger taxa					17	
		HBI					2.92	
		Total score					15	
		% score					83	
		Dominant taxa					<i>Serratella</i>	2
							<i>Epeorus</i>	1
							<i>Eukiefferiella</i>	3
		Periphyton						
		Siltation Index					1.75 - no stress	
		Disturbance Index					26.97 - minor stress	
DB-2	M12DBRNR03 Dearborn u/s	Macroinvertebrates						
		%tolerant taxa		8				
		no. EPT taxa		11				
		%clingers		69				
		no. clinger taxa		10				
		HBI		2.25				
		Total score		9				
		% score		50				
		dominant taxa		<i>Rhithrogena</i>	0			
				<i>Brachycentrus</i>	1			
				<i>Cricotopus</i>	8			
		Periphyton						
		Siltation Index		2.52 - no stress				
		Disturbance Index		43.27 - minor stress				
DB-3	M12DBRNR02 Dearborn @ Hwy 200	Macroinvertebrates						
		%tolerant taxa		29.15				
		no. EPT taxa		14				

Chart ID	Sample Site ID Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
		%clingers			53.4			
		no. clinger taxa			12			
		HBI			4.14			
		Total score			10			
		% score			56			
		dominant taxa			<i>Zaitzevia</i>	5		
					<i>Hydropsyche</i>	4		
					<i>Rhithrogena</i>	0		
		Periphyton						
		Siltation Index						
		Disturbance Index						
DB-4	M12DBRNR04 Dearborn @ 287	Macroinvertebrates						
		%tolerant taxa	24.56				14.6	
		no. EPT taxa	7				14	
		%clingers	26.32				74.9	
		no. clinger taxa	8				17	
		HBI	3.89				3.75	
		Total score	9				9	
		% score	50				50	
		dominant taxa					<i>Brachycentrus</i>	1
							<i>Rheotanytarsus</i>	6
							<i>Claasenia</i>	2
							<i>Hydropsyche</i>	4
		Periphyton						
		Siltation Index					6.9 - no stress	
		Disturbance Index					39.87 - minor stress	
DB-5	M12DBRNR06 Dearborn blw. Flat	Macroinvertebrates						
		%tolerant taxa					20.1	
		no. EPT taxa					15	
		%clingers					75.3	
		no. clinger taxa					20	
		HBI					3.8	
		Total score					9	
		% score					50	
		dominant taxa					<i>Hydropsyche</i>	4
							<i>Claasenia</i>	2
							<i>Brachycentrus</i>	1
		Periphyton						
		Siltation Index					8.56 - no stress	
		Disturbance Index					17.84 - no stress	

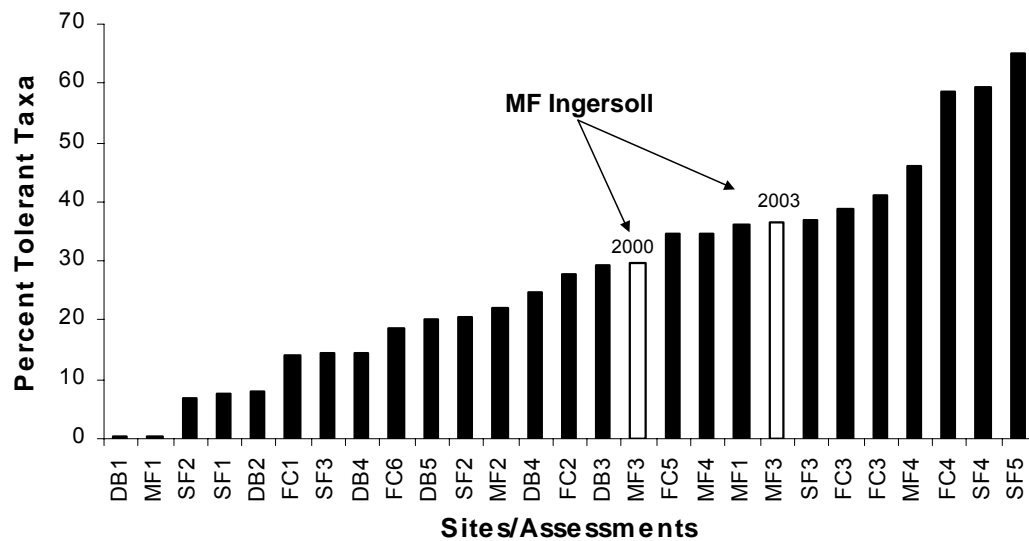


Figure C-1. Range of values for the metric Percent Tolerant Taxa over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

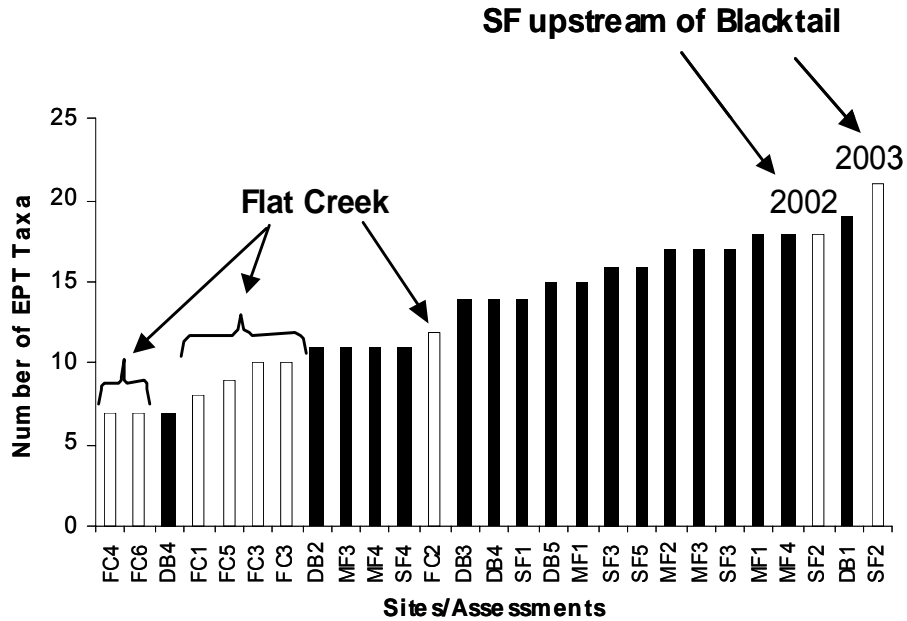


Figure C-2. Range of values for the metric Number of EPT Taxa over a 4-year sampling period, arranged in ascending order by site. Several sites were sampled in both 2002 and 2003.

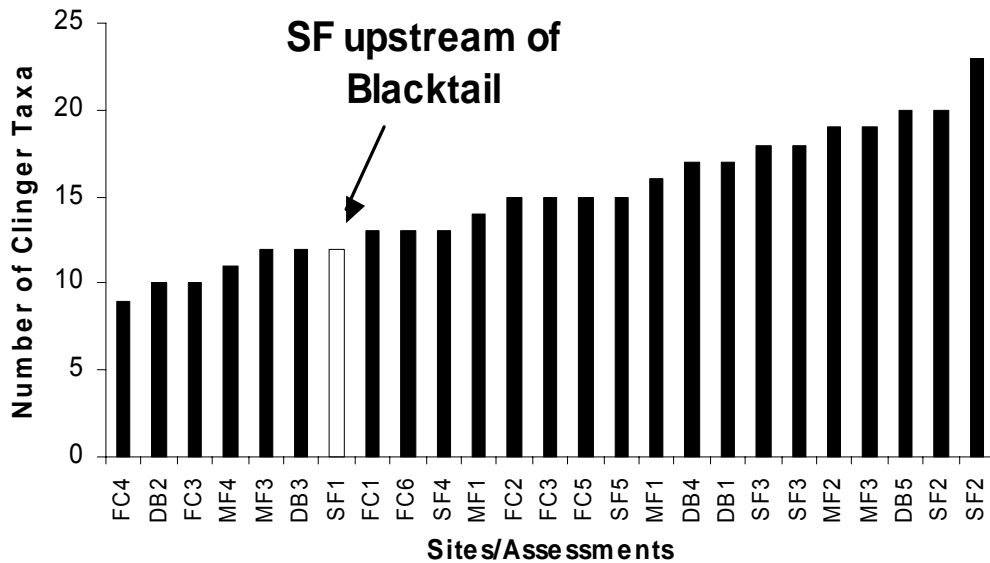


Figure C-3. Range of values for the metric Number of Clinger Taxa over a 4-year sampling period, arranged in ascending order by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

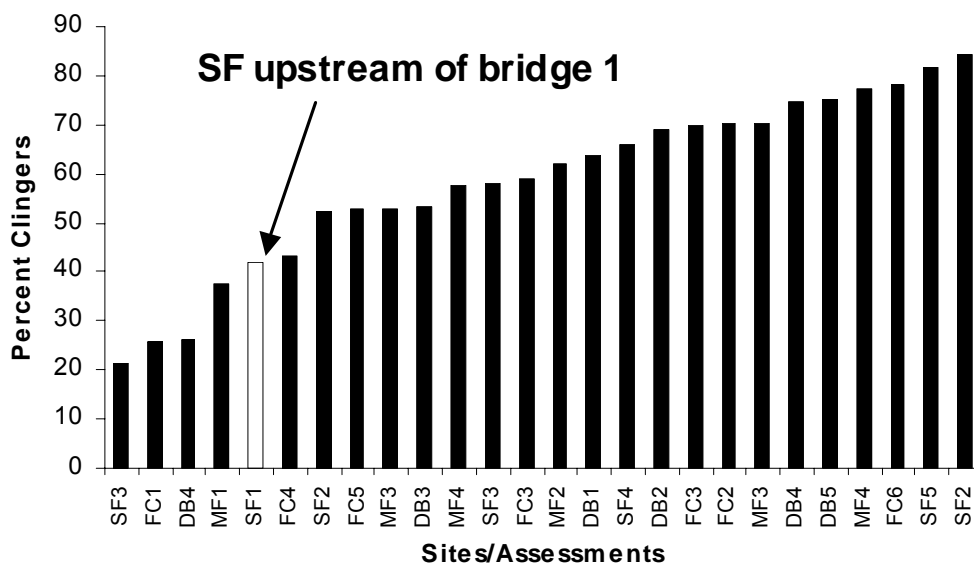


Figure C-4. Range of values for the metric Percent Clingers over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

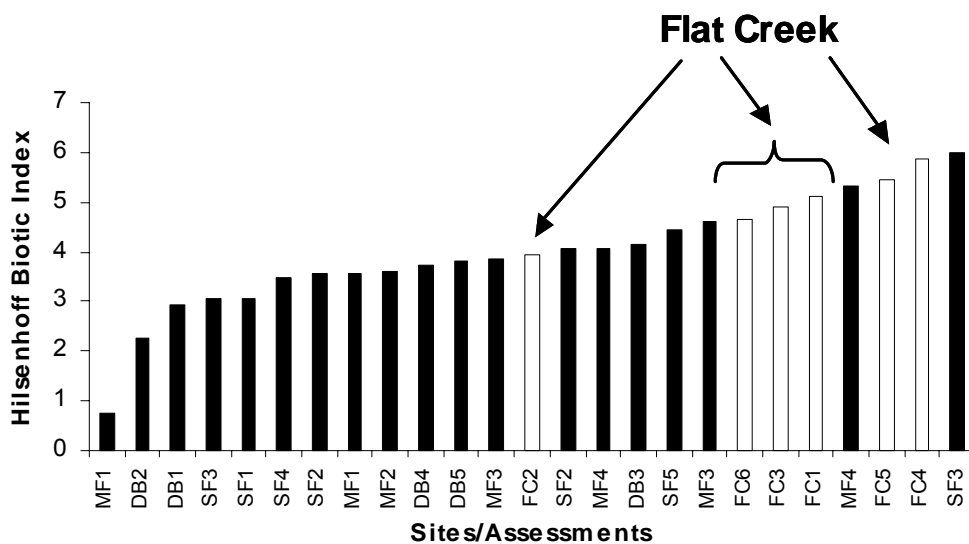


Figure C-5. Range of values for the metric Hilsenhoff Biotic Index over a 4-year sampling period, arranged in ascending order, by site. Several sites were sampled in both 2002 and 2003; a few sites had samples collected only in 2000.

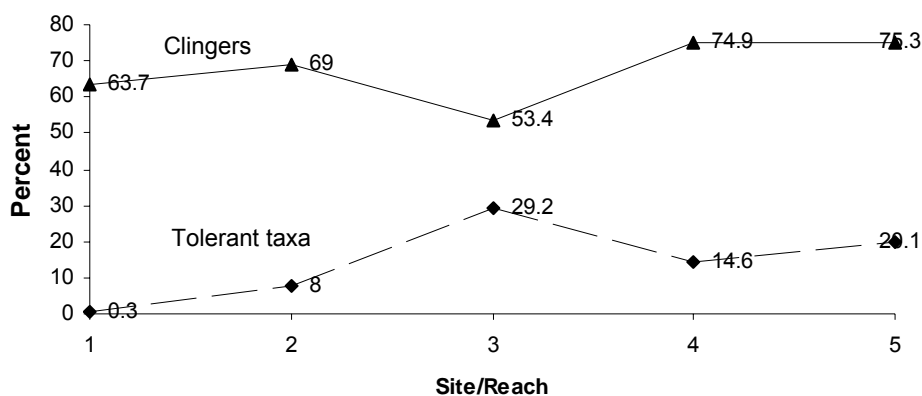


Figure C-6. Percent Clingers and Percent Tolerant Taxa from five reaches sampled on the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

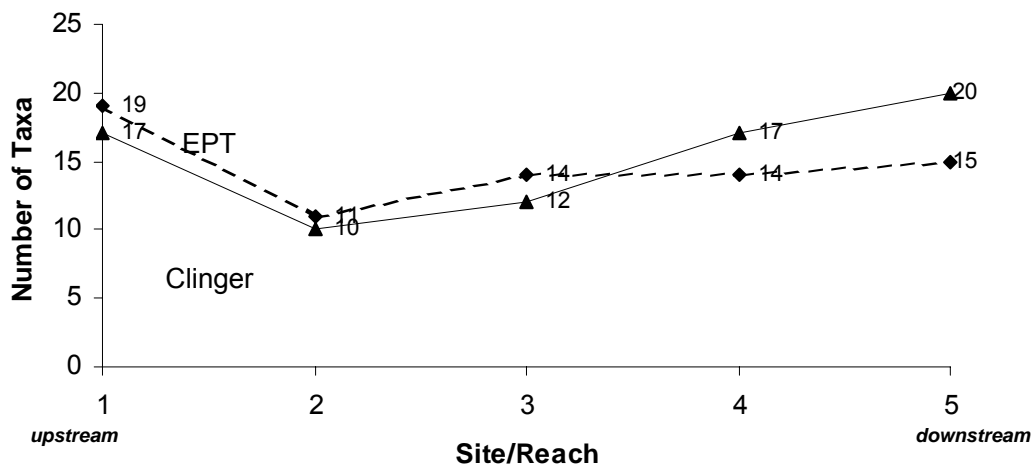


Figure C-7. Number of EPT Taxa and Clinger Taxa sampled from five reaches on the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

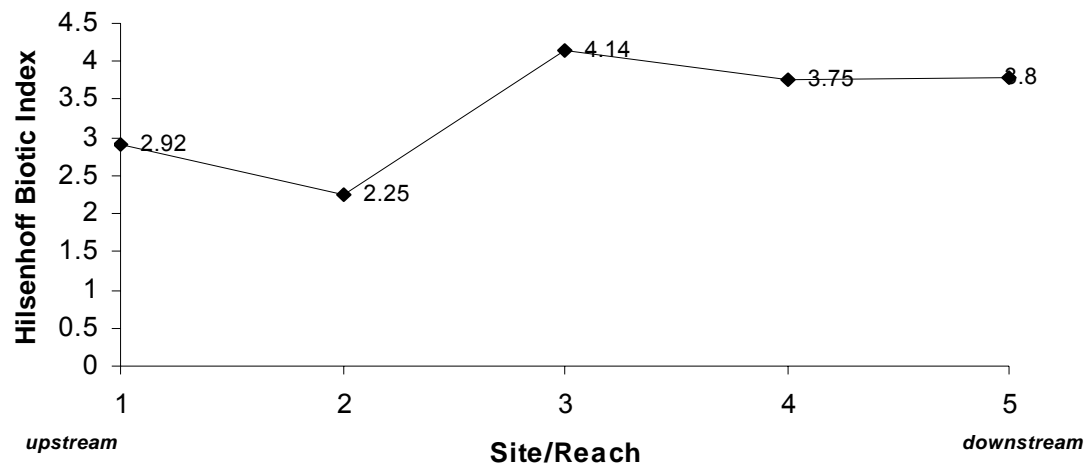


Figure C-8. Hilsenhoff Biotic Index from samples taken along five reaches of the Dearborn River mainstem from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-1.

SOUTH FORK DEARBORN RIVER**Table C-2. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance, and periphyton values for the South Fork of the Dearborn River**

chart ID	Sample Site ID Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
SF-1	SFD-1 SF Dearborn 100yds u/s first bridge and below Blacktail	Macroinvertebrate						
		%tolerant taxa	7.69					
		no. EPT taxa	14					
		%clingers	41.76					
		no. clinger taxa	12					
		HBI	3.08					
		Total score	14					
		% score	78					
		dominant taxa	<i>Orthocladius</i>	7				
			<i>Psychoglypha</i>	0				
			<i>Serratella</i>	2				
		Periphyton						
		Siltation Index						
		Disturbance Index						
SF-2	M12SFDBR01 SF Dearborn u/s Blacktail	Macroinvertebrate						
		%tolerant taxa			20.7		6.8	
		no. EPT taxa			18		21	
		%clingers			52.6		84.5	
		no. clinger taxa			20		23	
		HBI			4.06		3.55	
		Total score			13		10	
		% score			72		56	
		dominant taxa			<i>Orthocladius</i>	7	<i>Simulium</i>	4
					<i>Pagastia</i>	2	<i>Serratella</i>	2
					<i>Zaitzevia</i>	5	<i>Epeorus</i>	1
		Periphyton						
		Siltation Index			11.09 - no stress			
		Disturbance Index			16.91 - no stress			
SF-3	M12SFDBR02 SF Dearborn u/s 434	Macroinvertebrate						
		%tolerant taxa			14.4		36.9	
		no. EPT taxa			17		16	
		%clingers			21.23		57.9	
		no. clinger taxa			18		18	
		HBI			6.01		3.04	
		Total score			12		13	
		% score			67		72	
		dominant taxa			<i>Eukiefferiella</i>	3	<i>Agapetus</i>	0
					<i>Tveteria</i>	4	<i>Lepidostoma</i>	1
					<i>Skwala</i>	3	<i>Ochrotrichia</i>	4
		Periphyton						
		Siltation Index			31.84 - no stress			
		Disturbance Index			6.87 - no stress			
SF-4	SFD-4 SF Dearborn d/s	Macroinvertebrate						
		%tolerant taxa	59.25					
		no. EPT taxa	11					

chart ID	Sample Site ID Site Name	Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
	434	%clingers	66.14					
		no. clinger taxa	13					
		HBI	3.47					
		Total score	9					
		% score	50					
		dominant taxa	<i>Optioservus</i>	3				
			<i>Sweltsa</i>	0				
		Periphyton						
		Siltation Index						
		Disturbance Index						
SF-5	M12SFDBR04 SF Dearborn @ Confluence	Macroinvertebrate						
		%tolerant taxa					65.1	
		no. EPT taxa					16	
		%clingers					81.7	
		no. clinger taxa					15	
		HBI					4.44	
		Total score					13	
		% score					72	
		dominant taxa					<i>Optioservus</i>	3
							<i>Zaitzevia</i>	5
							<i>Nixe</i>	4
		Periphyton						
		Siltation Index						
		Disturbance Index						

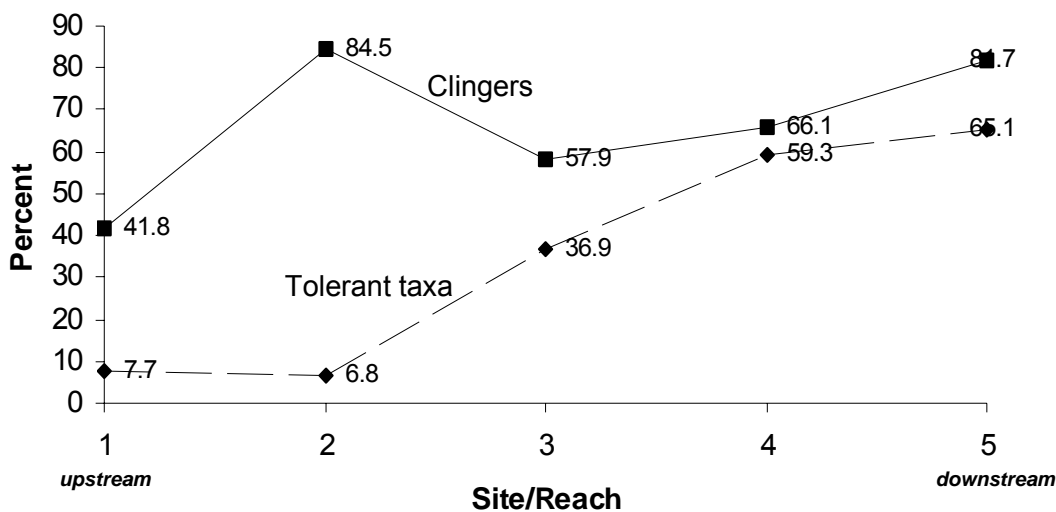


Figure C-9. Percent clingers and percent tolerant along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-2.

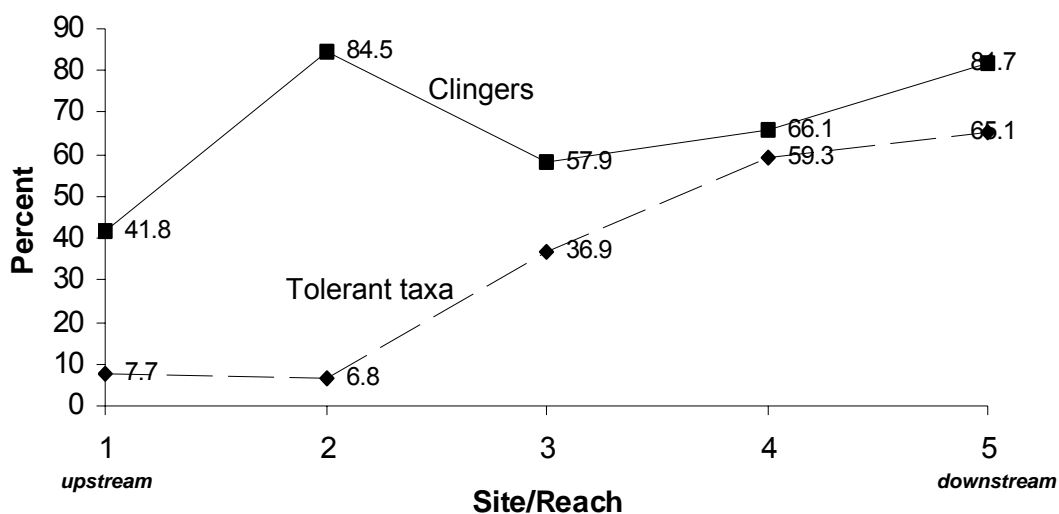


Figure C-10. Percent clingers and percent tolerant along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are used. Reach numbers refer to Table C-2.

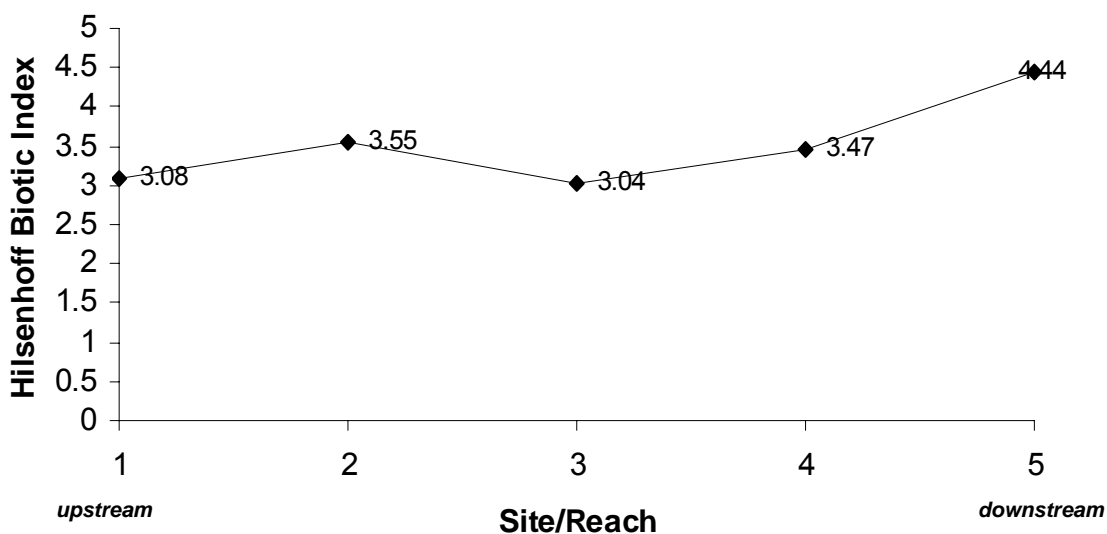


Figure C-11. Hilsenhoff Biotic Index from samples collected along 5 sites of the South Fork Dearborn River, sampled from 2000-2003; the most recent data from each sites are shown. Reach numbers refer to Table C-2.

MIDDLE FORK DEARBORN RIVER**Table C-3. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance, and periphyton values for the Middle Fork of the Dearborn River**

Middle Fork of the Dearborn River Biological Data Summary Table								
Chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
MF-1	M12MFDBR01 MF Dearborn @ Rogers Pass	Macroinvertebrates						
		%tolerant taxa			36.1		0.3	
		no. EPT taxa			18		15	
		%clingers			37.5		85.6	
		no. clinger taxa			16		14	
		HBI			3.58		0.77	
		Total score			14		16	
		% score			78		89	
		dominant taxa			<i>Baetis</i>	5	<i>Epeorus</i>	1
					<i>Drunella</i>	1	<i>Cinygmula</i>	0
					<i>Hydrobaenus</i>	8	<i>Drunella</i>	1
		Periphyton						
		Siltation Index			4.43 - no stress			
		Disturbance Index			55.38 - mod. stress			
MF-2	MFD-2 MF Dearborn u/s 200	Macroinvertebrates						
		%tolerant taxa	22.1					
		no. EPT taxa	17					
		%clingers	62.2					
		no. clinger taxa	19					
		HBI	3.6					
		Total score	10					
		% score	56					
		dominant taxa	<i>Pagastia</i>	2				
			<i>Ochrotrichia</i>	4				
			<i>Orthocladius</i>	7				
		Periphyton						
		Siltation Index						
		Disturbance Index						
MF-3	M12MFDBR04 MF Dearborn @ Ingersoll	Macroinvertebrates						
		%tolerant taxa	29.55				36.7	
		no. EPT taxa	11				17	
		%clingers	52.9				70.3	
		no. clinger taxa	12				19	
		HBI	4.6				3.86	
		Total score	10				11	
		% score	56				61	
		dominant taxa	<i>Polypedilum</i>	7			<i>Zaitzevia</i>	5
			<i>Orthocladius</i>	7			<i>Brachycentrus</i>	1
			<i>Optioservus</i>	3			<i>Optioservus</i>	3
			<i>Zaitzevia</i>	5				
		Periphyton						
		Siltation Index						
		Disturbance Index						
MF-4	M12MFDBR02 MF Dearborn	Macroinvertebrates						
		%tolerant taxa			34.6		46.1	
		no. EPT taxa			11		18	

Middle Fork of the Dearborn River Biological Data Summary Table								
Chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
	d/s 434	%clingers			57.7		77.4	
		no. clinger taxa			11		18	
		HBI			5.34		4.08	
		Total score			8		11	
		% score			44		61	
		dominant taxa			<i>Tanytarsus</i>	7	<i>Zaitzevia</i>	5
					<i>Optioservus</i>	3	<i>Optioservus</i>	3
					<i>Zaitzevia</i>	5	<i>Brachycentrus</i>	1
		Periphyton						
		Siltation Index			11.38 - no stress			
		Disturbance Index			22.54 - no stress			

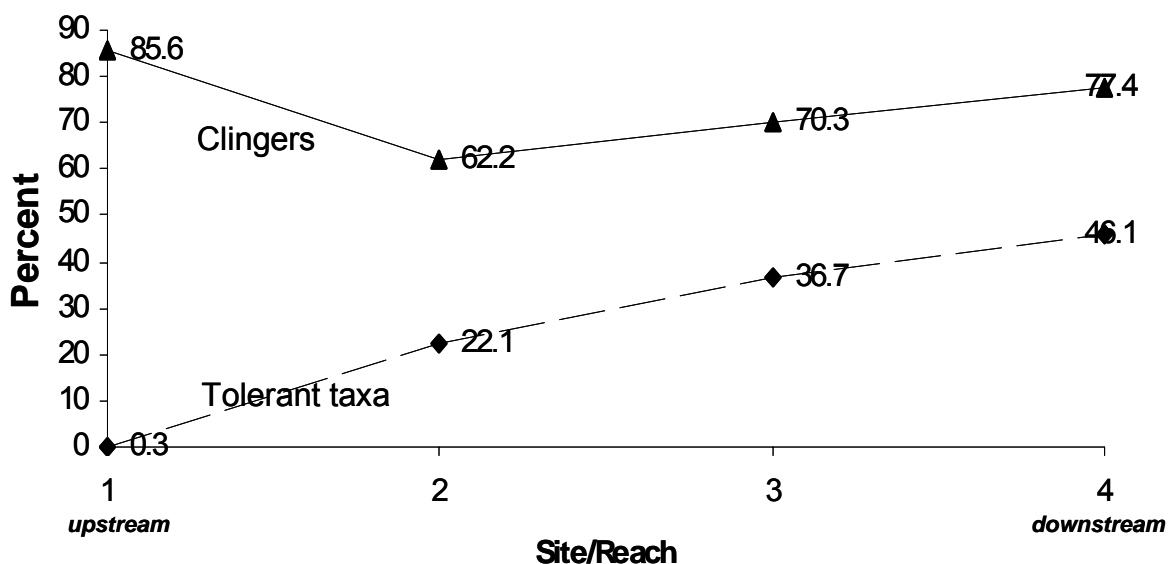


Figure C-12. Percent clingers and tolerant taxa from samples collected along 4 sites of the Middle Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-3.

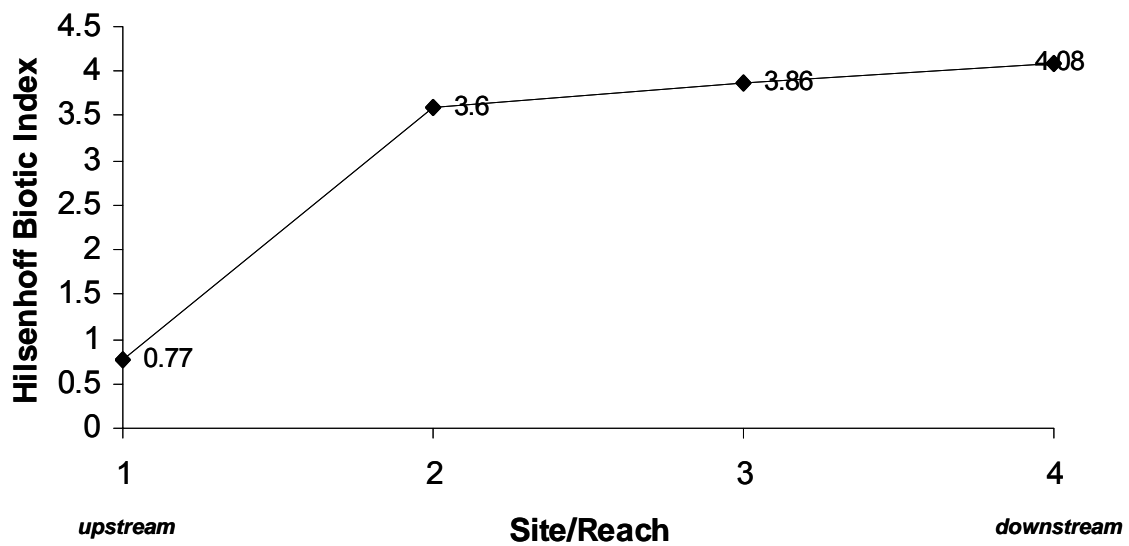


Figure C-13. Hilsenhoff Biotic Index from samples collected along 4 sites of the Middle Fork Dearborn River, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-3.

FLAT CREEK**Table C-4. Selected benthic macroinvertebrate metrics, dominant taxa, and Montana revised tolerance values for Flat Creek**

Flat Creek Macroinvertebrate Data Summary Table								
chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
FC-1	M12FLATC02 Flat creek on Flat Crk Rd.	Macroinvertebrates						
		%tolerant taxa	14.1					
		no. EPT taxa	8					
		%clingers	25.7					
		no. clinger taxa	13					
		HBI	5.11					
		Total score	9					
		% score	50					
		dominant taxa	<i>Orthocladius</i>	7				
			<i>Eukiefferiella</i>	3				
			<i>Cricotopus</i>	8				
		Periphyton						
		Siltation Index						
		Disturbance Index						
FC-2	M12FLATC05 Flat creek @ Milford	Macroinvertebrates						
		%tolerant taxa					27.7	
		no. EPT taxa					12	
		%clingers					70.3	
		no. clinger taxa					15	
		HBI					3.94	
		Total score					8	
		% score					44	
		dominant taxa					<i>Brachycentrus</i>	1
							<i>Baetis</i>	5
							<i>Optioservus</i>	3
		Periphyton						
		Siltation Index					25.96 - no stress	
		Disturbance Index					18.6 - no stress	
FC-3	M12FLATC03 Flat creek u/s Hwy 200	Macroinvertebrates						
		%tolerant taxa	41				38.8	
		no. EPT taxa	10				10	
		%clingers	59				70.1	
		no. clinger taxa	10				15	
		HBI	4.58				4.9	
		Total score	7				5	
		% score	39				28	
		dominant taxa					<i>Hydropsyche</i>	4
							<i>Brachycentrus</i>	1
							<i>Optioservus</i>	3
		Periphyton						
		Siltation Index					33.79 - no stress	
		Disturbance Index					14.48 - no stress	
FC-4	F-7 Flat creek u/s Birdtail Rd	Macroinvertebrates						
		%tolerant taxa	58.68					
		no. EPT taxa	7					
		%clingers	43.11					
		no. clinger taxa	9					
		HBI	5.85					

Flat Creek Macroinvertebrate Data Summary Table								
chart ID	Sample Site ID Site Name	Macroinvertebrate Metrics/Variables	2000		2002		2003	
			Value	TV	Value	TV	Value	TV
		Total score	4					
		% score	22					
		dominant taxa	<i>Simulium</i>	4				
			<i>Baetis</i>	5				
			<i>Tricorythodes</i>	5				
		Periphyton						
		Siltation Index						
		Disturbance Index						
FC-5	M12FLATC08 Flat creek blw. Birdtail	Macroinvertebrates						
		%tolerant taxa					34.6	
		no. EPT taxa					9	
		%clingers					52.7	
		no. clinger taxa					15	
		HBI					5.45	
		Total score					6	
		% score					33	
		dominant taxa					<i>Baetis</i>	5
							<i>Hydropsyche</i>	4
							<i>Cheumatopsyche</i>	7
		Periphyton						
		Siltation Index					24.53 - no stress	
		Disturbance Index					4.34 - no stress	
FC-6	M12FLATC04 Flat creek @ Mouth	Macroinvertebrates						
		%tolerant taxa					18.7	
		no. EPT taxa					7	
		%clingers					78.3	
		no. clinger taxa					13	
		HBI					4.65	
		Total score					5	
		% score					28	
		dominant taxa					<i>Hydropsyche</i>	4
							<i>Antocha</i>	5
							<i>Optioservus</i>	3
		Periphyton						
		Siltation Index					14.29 - no stress	
		Disturbance Index					2.98 - no stress	

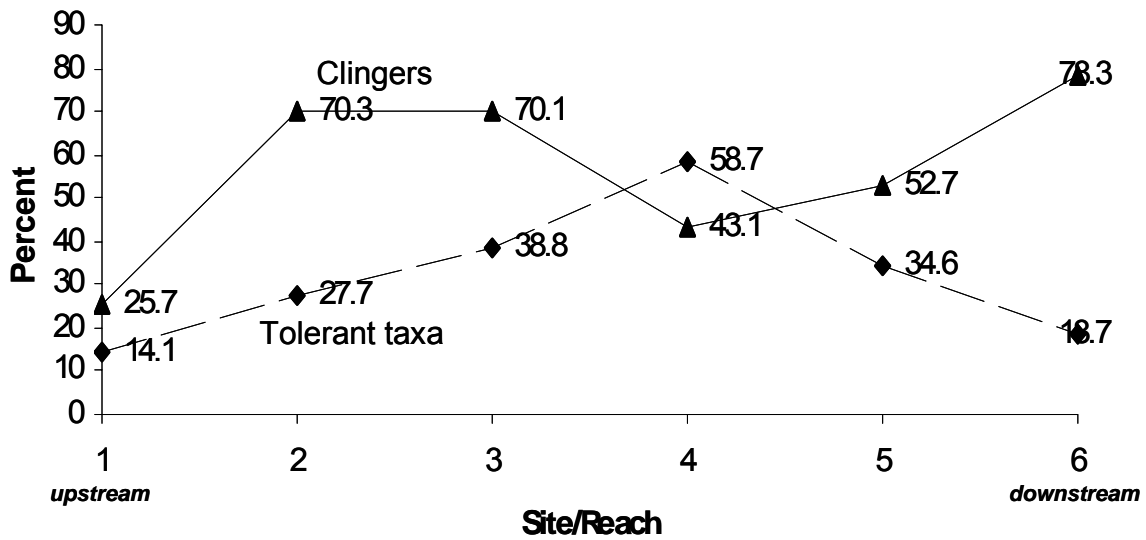


Figure C-14. Percent clingers and tolerant taxa from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

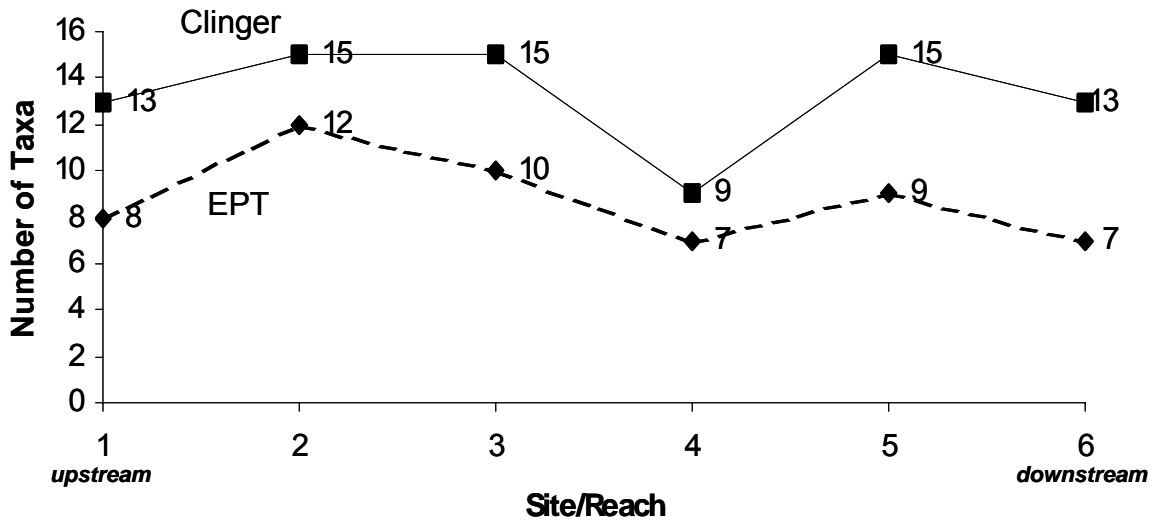


Figure C-15. Number of clinger and EPT taxa from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

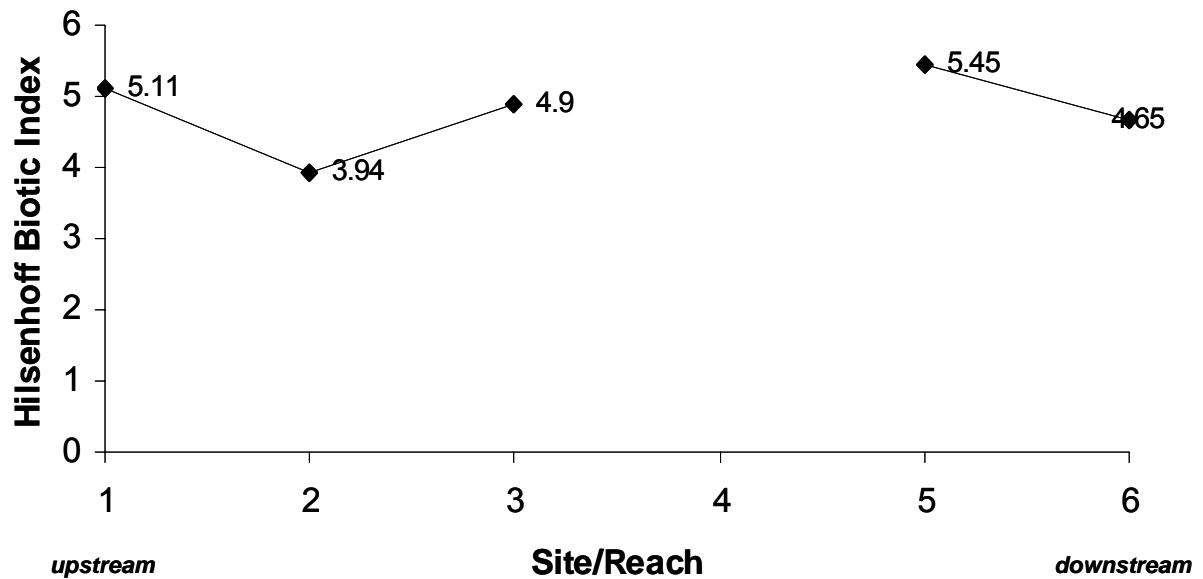


Figure C-16. Hilsenhoff Biotic Index from samples collected along 6 sites of the Flat Creek mainstem, sampled from 2000-2003; the most recent data from each site are shown. Reach numbers refer to Table C-4.

APPENDIX D: CHANNEL AND RIPARIAN AERIAL ASSESSMENT

DEARBORN TMDL PLANNING AREA

Channel and Riparian Aerial Assessment



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1.0 INTRODUCTION

An assessment of channel and riparian vegetation in the Dearborn River watershed was conducted using aerial methods to provide support for TMDL planning. The Dearborn River watershed is a tributary to the Missouri River in western central Montana, north of Helena. This assessment includes the Dearborn River, the Middle and South forks of the Dearborn, and Flat Creek.

The overall objectives of the aerial assessment were as follows:

- Provide information about surface physical stream corridor conditions as required to support determinations of impairment and beneficial use status.
- Identify potential causes and sources of natural resource concerns when feasible.
- Establish a baseline of current resource conditions and indicators along the stream corridor for future trend monitoring
- Support recommendations for natural resource restoration and protection strategies along the stream corridor and important uplands within the watershed.
- Serve as a source of background information and interpretations to support future requests for technical and financial assistance to carry out watershed planning efforts.

Assessment methods included interpretation of available aerial photographs and aerial reconnaissance. These are described in the following section.

2.0 METHODS

The aerial assessment included both photo interpretation and fixed-wing rapid aerial assessment. Photo interpretation was accomplished prior to the flights so interpretations could be confirmed during the flyovers. Aerial photos considered in the Dearborn assessment included flights from 1955, 1964, and 1995 (**Table 2-1**).

Table 2-1 *Aerial Photo Sources*

Source	Date	Coverage
NRCS	1955	Central Dearborn Mainstem, portions of Flat Creek
NRCS	1964	Central Dearborn Mainstem, portions of Flat Creek
NRCS, Digital Orthoquads	1995	Complete Coverage of Watershed

Still photographs of the 2003 aerial reconnaissance are found in **Appendix C** (separate volume). Plots of the 1995 aerial photos with 2003 still photo inserts are found in **Appendix D**. These photo inserts were captured from continuous video coverage recorded in Hi-8 format and are a subset of photos found in **Appendix C**.

Specifically, the photo assessment included the following:

- Define Rosgen Level 1 classification and reach breaks,
- Stream length changes/meander cutoffs/sinuosity measurements,
- Channel bar/aggradation/incisement conditions and other indicators of vertical stability problems,

- Bank erosion and trend over time based on historic aerial photographs (channel width measured to evaluate movement of the stream and identify stream widening/narrowing),
- Riparian conditions and plant community characteristics (e.g. plant community, percent canopy cover/density),
- Location of major wetlands,
- Major sediment sources or mass wasting in the project area,
- Major land use changes,
- Potential reference condition metrics,
- Location of roads/culverts/channel intersections,
- Location of major water diversions,
- Areas that appear to be adversely impacted and require field investigations.

The aerial assessment involved two fixed-wing flights over the listed reaches and major tributaries. Video (Hi-8 format) and still photographs were recorded at an oblique angle (approx. 30 degrees ahead from vertical) from an elevation of 4500 ft and an average air speed of 90 mph. A second flight was made to confirm physical feature attribute data along the stream corridor. An aircraft with 2 crewmembers (a pilot, and a technician to record features) conducted the inventory.

Documentation of physical features was based on the visual observation and interpretation of the technician. Recorded features included:

Point Features

- Impoundments – Reservoirs on or immediately adjacent to the stream corridor,
- Instream Structures – Diversions, turnouts, pump sites,
- Headcuts – Active downcutting on side drainages,
- Potential Water Quality Point Sources - Corrals, feedlots, sewage discharge, irrigation return flows, dump sites, etc. along or adjacent to the stream corridor,
- Stream Crossings – Bridges, pipelines, culverts, ford crossings,
- Riparian Characteristics -
- Vegetation attributes (trees, shrub, mixed, grass sedge),
- Density (% Canopy Coverage),
- Point of reference characterized by apparent disturbance (low density, limited age class distribution, or species diversity, low vigor) by any source,
 - Point of reference characterized by apparent low levels of disturbance,
- Other – Car bodies, gravel pits, construction sites, etc. located along the stream.

Linear Features

- Bank Erosion – Accelerated, active erosion of stream banks,
- Mass Bank Sloughing – Natural sloughing of high terraces/banks,
- Rock Riprap – Round river stone, angular rock or other bank armor,
- Channelized Segment –artificial (human-induced) manipulation of the channel,
- Other (incised channel, etc.).

Data was marked on 1995 digital orthoquads (DOQ's). Variables measured are detailed in **Appendix A** and data tables are found in **Appendix B**.

3.0 RESULTS

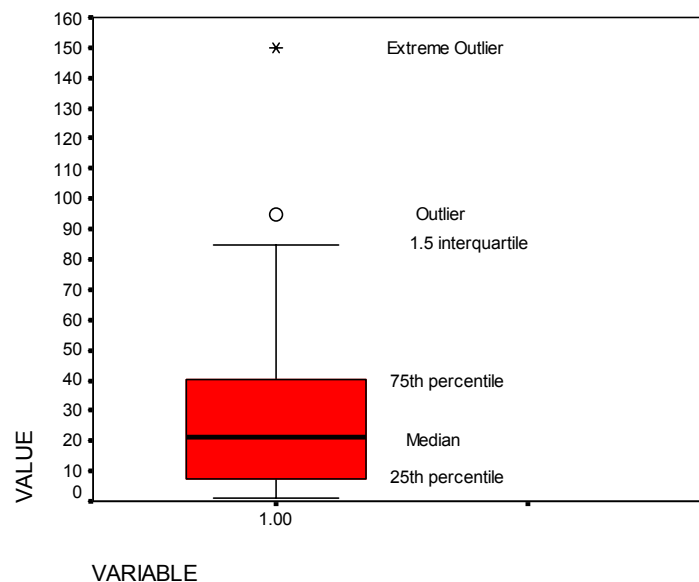
This section presents an analysis of channel and riparian condition for the Dearborn River Watershed. Analysis of results is grouped into stream reaches with identification as follows:

- DR: Dearborn Mainstem (6 Reaches, DR1, DR2, DR3, DR4, DR5, DR6).
- SF: South Fork of the Dearborn (2 reaches, SF1, SF2).
- MF: Middle Fork of the Dearborn (2 reaches, MF1, MF2).
- FC: Flat Creek (4 reaches, FC1, FC2, FC3, FC4).

Reach locations are depicted in **Figure 1** (pocket insert). Point observations for each variable were made at 10 to 70 locations within each reach depending on reach length and variability. This corresponded to a transect/point observation interval of approximately 1100 to 2500 feet within each delineated reach. Reference point numbers are found on the aerial photo sheets.

Results of analyses are presented as boxplots showing the central tendency (median) and distribution of data (**Figure 3-1**).

Figure 3-1. Example Boxplot



The central black bar is the median or 50th percentile value, which is equivalent to the average when data are normally distributed. The 25th and 75th percentiles are shown as the lower and upper extents of the box. The “whiskers” represent the value of 1.5 times the interquartile range. Circles represent outliers in the distribution of data, and asterisks represent extreme outliers. Normally distributed data would have a symmetrical form around the median value.

3.1 Channel Morphology and Condition

3.1.1 Background

Dearborn River

The mainstem of the Dearborn River is primarily an alluvial, gravel bed river (Rosgen Type C4) with a small to moderately extensive floodplain. Significant reaches of the channel are confined by deeply dissected terrain and canyon walls. Areas of lateral and vertical bedrock control are present, and this confinement has resulted in limited lateral floodplain development in some reaches. A short section of unstable braided channel is present in the transition from the headwaters near Falls Creek/Bean Lake (Reach DR6).

Middle Fork Dearborn

The Middle Fork of the Dearborn River is a C4 channel in the foothills/plains; however, a significant portion of the total stream length is a steeper gradient, headwaters B3/4 and A3 type channel. The channel makes this transition to B type morphology upstream of Highway 200 which then parallels the Middle Fork of the Dearborn to the headwaters. The extensive road fill slopes from Highway 200 do not encroach on the floodplain or result in geomorphic impacts to the perennial reaches of the Middle Fork. Lower reaches of the Middle Fork are predominately C4 type channel. Channel stability appeared to be closely related to riparian health. Increased channel width and bank instability were associated with loss of riparian vegetation.

South Fork Dearborn

The South Fork has characteristics similar to the Middle Fork, and much of the headwater zone is relatively undisturbed, steep forested terrain. Some land use (vegetation removal) impacts on channel morphology are apparent in the central reaches, and riparian vegetation is largely limited to willow and other shrub species. The river becomes an alluvial, gravel substrate channel (Rosgen C4) in the lower reaches. Channel stability appeared correlated to riparian vegetation health to some extent.

Flat Creek

Flat Creek is a low gradient, meandering channel with fine to very fine gravel bed materials (Rosgen C4/F4 channel type, tending towards C5/F5 in upper reaches). Flat Creek serves as a conveyance for irrigation water diverted from the mainstem of the Dearborn and channel morphology reflects this altered flow regime. Channel cross section is enlarged due to diverted irrigation flows and some channel erosion/instability is present in localized areas. Observed channel instability is likely the result of increased flows due to irrigation diversion and conversion of riparian vegetation to agricultural uses. Grazing and agricultural uses (pasture and cropland) were widespread in Flat Creek. Grazing appeared to be of higher intensity in the lower reaches.

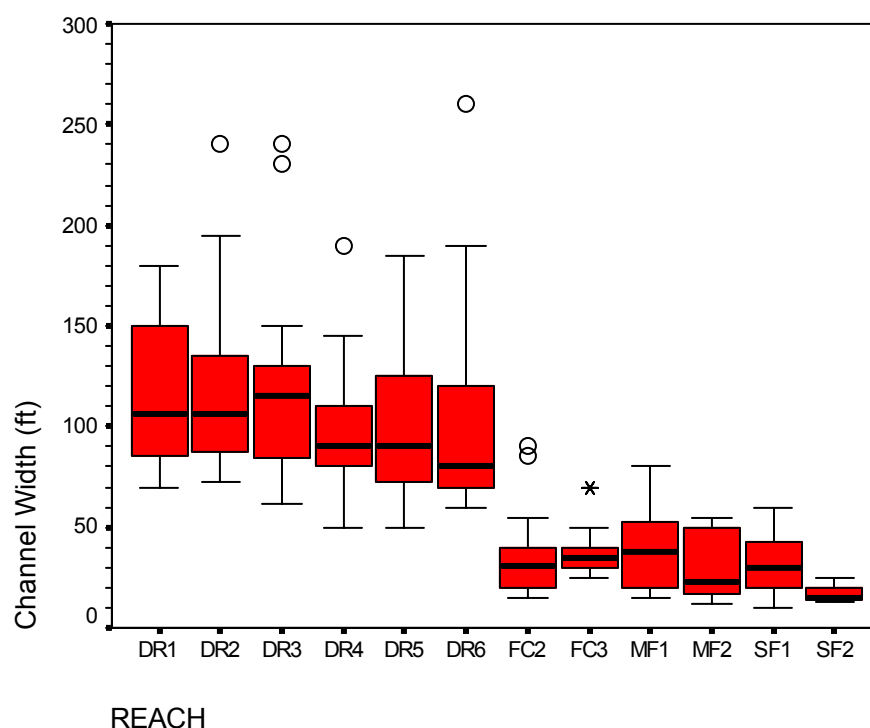
3.1.2 Channel Characteristics

Dearborn Mainstem

Six reaches were defined for the Dearborn mainstem (**Table 3-1**). Much of the mainstem channel was a Rosgen C4 channel type, although local inclusions of coarser substrate C3 or bedrock controlled channel appeared to be present in some areas.

Channel width ranged from 100 to 120 feet, generally increasing in the downstream direction. Channel width measures approximate bankfull width, but may be biased slightly high due to the tendency to include recently deposited gravel, or older un-vegetated gravel deposits near bankfull elevation in this measurement. The uppermost reach (DR6) had a short braided section that was a D4 channel type. Channel slope decreased from 0.008 in the upper reach (DR6) to 0.005 in the lower reach (DR1), and sinuosity ranged from 1.1 to 1.25 overall.

Figure 3-2 Channel Width in the Dearborn Watershed in 1995



Bank stability was assessed using 1995 aerial photos and video coverage. Stability scores were intended to approximate Rosgen Bank Erosion Hazard Index (BEHI) values. Banks rated “high” were generally vertical banks or high terraces with primarily herbaceous riparian vegetation. Moderate scores were assigned to banks that had sparse or patchy woody vegetation and steep to moderately sloped banks. Banks that had abundant woody vegetation and moderate to low angled banks were assigned a “low” score. This aerial assessment method was a coarse, screening level tool and could not evaluate for all the factors (e.g. bank height ratio, surface protection, etc) required to make a BEHI assessment. Nevertheless, it provided a simplified

approach to rapid assessment of bank stability which was able to discern potential sediment source areas.

BEHI scores were similar for Dearborn mainstem reaches DR1, DR2, and DR4, with 8 to 12.3% of banks with “high” scores, and 87-92% in the moderate to low (i.e. stable) category. Reach DR3 had a higher proportion of banks in the high category (27%). Unlike downstream reaches DR1 and DR2, which are located in dissected “canyonland” topography, DR3 had an unconfined channel and active floodplain. Elevated width to depth ratios and meander cutoffs were therefore characteristic of this reach. BEHI ranking in reaches DR5 and DR6 indicated more instability than downstream reaches, with 21 to 47% of banks falling in the high (i.e. unstable) category. In particular, reach DR6 showed a significant proportion of unstable banks due to the braided (Rosgen D4) morphology. Aerial photos from 1955 and 1964 were not available to assess whether this braided character was related to flood damage in 1964. However, the location of reach DR6 in the transition from confined valley to unconfined plains is a common location for sediment adjustments to occur, and braided D or unstable C morphology is frequently observed.

Table 3-1 Stream Channel Characteristics – Dearborn Watershed, 1995

Reach	Reach Length (mi)	Channel Type	Slope	Sinuosity	Channel Width (ft)	BEHI Rating (% of Reach)			Overall Channel Stability
						High	Mod	Low	
DR1	8.88	C4	0.005	1.15	115	8.1	38.3	53.6	Good
DR2	9.52	C4	0.006	1.25	117	12.3	42.1	45.6	Good
DR3	8.00	C4	0.007	1.13	120	27.4	35.3	37.3	Fair-Good
DR4	8.15	C4	0.007	1.22	100	11.8	41.2	47.1	Good
DR5	7.436	C4	0.008	1.04	100	21.2	28.8	50.0	Fair
DR6	6.53	D4	0.008	1.1	107	47.1	26.2	26.6	Poor
SF1	5.83	C4	0.012	1.22	34	8.3	25.0	65.7	Fair to Good
SF2	5.56	B4/A3	0.017	1.09	17	0.0	9.0	84.7	Good to Excellent
MF1	6.17	C4	0.015	1.25	39	10.6	35.3	54.1	Fair to Good
MF2	1.32	B4/A3	0.025	1.09	30	0.0	19.4	80.6	Good-Excellent
FC1	7.49	C4	0.007	1.6	49	11.2	17.7	71.1	Fair
FC2	4.43	C5/E5	0.006	1.55	36	13.1	36.9	50.0	Poor-Fair
FC3	4.35	C5/E5	0.006	1.28	38	14.0	30.8	55.2	Fair
FC4	11.64	C5/E5	0.006	1.3	19	8.4	33.3	58.3	Fair

A reference reach representative of unconfined C4 channel morphology was not readily apparent in the central reaches of the Dearborn. Review of aerial photography and 2003 aerial reconnaissance indicated that much of the C4 channel outside of the “canyon” or confined areas was laterally active with frequently high width to depth ratios and variable density of tree/woody shrub riparian vegetation.

Overall, BEHI scores were consistent with unimpacted bank conditions in reaches DR1, DR2, and DR4 for this channel type and geologic setting. Human impacts were not associated with “high” scores in these reaches and these banks were generally natural landscape features. Reach DR3 had a significant proportion of banks in the “high” category. Reach DR3 was an

unconfined alluvial channel and BEHI scores would be expected to be higher for this reach. However, human impacts were apparent in portions of this reach and high BEHI rankings also appeared to be related to degraded riparian vegetation in some areas. The upper reaches DR5 and DR6 also had a large proportion of high BEHI scores. In particular, DR6 ranked poorly due to natural braided channel morphology. High BEHI scores were not related to human impacts and are likely related to natural processes rather than land use issues.

Dearborn South Fork

Two reaches were defined for the Dearborn South Fork (**Table 3-1**). Rosgen classification suggests that the lower reach (SF1) was a C4 channel type, and the upper reach (SF2) was a B4 to A3 channel. Analysis for the upper reach extended into the beginning of the forested headwaters.

Average channel width in SF1 was 34 feet, and the upstream reach SF2 averaged 17 feet. Channel slope decreased from 0.017 in the upper reach (SF2) to 0.012 in the lower reach (SF2), and sinuosity was 1.09 and 1.22, respectively.

Bank stability in the South Fork was generally good, with only 8.3% of banks in reach SF1 showing high BEHI scores, and <1% unstable banks in the upper reach SF2. Reach SF1 did show evidence of moderate instability with 25% of banks in this category. SF2 had significantly less bank in the moderate category (9%); the majority of the channel banks (85%) ranked good for stability (i.e. “low” BEHI ranking).

The relative differences in SF1 and SF2 bank stability are related primarily to channel type, and secondarily to vegetation and/or land use. SF2 is primarily forested A and B channel types in the headwaters, and has a relatively limited component of C channel in the lower part of the reach. SF2 is inherently more stable than SF1 because of this morphology.

Vegetation does appear to play a role in channel morphology and stability in the lower reach SF1. This is apparent from examination of aerial photography and visually comparing adjacent reaches with different vegetation densities. Hay/pasture and grazing in SF1 were associated with higher BEHI scores. The influence of riparian vegetation modification is more pronounced in the Middle Fork than the South Fork, however.

Dearborn Middle Fork

Two reaches were defined for the Dearborn Middle Fork (**Table 3-1**). The lower reach (MF1) was a Rosgen C4 channel type, and the upper reach (MF2) was a B4 at the lower end, and an A3 channel type in the headwaters. Analysis for the upper reach MF2 extended only partway into the forested headwaters because overhead canopy and small channel size limited quantitative measures. Average channel width in MF1 was 39 feet, and the upstream reach MF2 averaged 30 feet.

Bank stability assessment in the Middle Fork reach MF1 showed 11% of banks in reach MF1 with high BEHI scores and 35% with moderate scores. The upper reach MF2 had no banks with high BEHI scores. It should be noted that the aerial assessment did not cover detailed

assessment of the uppermost reaches of MF2 due to dense canopy cover. Had this been feasible, the overall BEHI rating of reach MF2 would improve substantially due to more stable channel types/reaches in the headwaters.

Vegetation appeared to play a strong role in channel morphology and stability in the lower reach MF1. This is apparent from examination of aerial photography and visually comparing adjacent reaches with different vegetation densities. High and moderate BEHI scores were associated with loss of riparian vegetation and agricultural impacts.

Flat Creek

Four reaches were defined for Flat Creek (**Table 3-1**). The lower reach (FC1) was a Rosgen C4 channel type. Morphology suggested that substrate is predominately coarse gravel with bedrock control in some areas. Central reaches FC2 and FC3 appeared to be Rosgen types C5 or E5 channel types. The uppermost reach FC4 was also classified as a C5/E5 channel type. Average channel width in the lower reach of Flat Creek (FC1) was 49 feet, central reaches (FC2 and FC3) averaged 36 and 38 feet respectively. Flat Creek Reach FC4 had an average width of 19 feet.

Flat Creek appeared slightly incised in the central reaches. This suggested that Flat Creek has experienced downcutting (tending to F5 channel type) due to the diversion of irrigation water and is re-establishing equilibrium C or E morphology.

BEHI assessment indicated that 8.4 to 11.2% of bank length in Flat Creek scored “high”. Moderate bank erosion scores accounted for 18-37% of total bank length. Reaches FC1, FC2, FC3, and FC4 were similar in the distribution of bank stability. It should be noted that eroding banks originated both from human impacts and also areas where the active channel intersected natural terraces and hillsides. Eroding banks associated with topographic features can be related to human impacts; however, they can also be natural and unrelated to land use. In this case, the majority of eroding banks were associated with human impacts.

Flat Creek is a highly altered system with diverted irrigation water and extensive conversion of riparian areas to pasture or cropland. Loss of beaver from the system may also be a significant factor in modified channel morphology. Reference reaches were not apparent in Flat Creek. Prior to conversion to an irrigation conveyance, the channel of Flat Creek was certainly a narrower, more stable channel. Given the current flow regime and corresponding geomorphic adjustments, potential “reference” or “equilibrium” conditions and potential bank stability criteria would be best defined through field investigation.

3.2 Riparian Condition

Fully functioning, healthy riparian vegetation communities can reduce stream bank erosion, filter sediment, dissipate the energy of flood flows, and provide a healthy and contiguous environment for both terrestrial and aquatic biota.

The distribution and composition of the riparian vegetation community is a function of the physical and chemical properties of the soils, moisture, elevation, and aspect. Site characteristics can be altered by both natural and man-induced causes. For example, an extreme flood event in

the Dearborn River drainage in 1964 significantly altered the physical characteristics of many stream floodplains as well as the character of the riparian vegetation communities. The effects from 1964 flooding are still evident in the riparian community (see **Section 3.3**). Man's actions can also have an effect on the riparian vegetation community. Riparian harvest, the presence of roads, stream crossings, agricultural encroachment, irrigation, and grazing can all have deleterious effects on riparian vegetation communities.

A potentially significant anthropogenic factor in riparian vegetation communities is grazing. Present-day grazing pressure is mainly related to cattle although at the turn of the century large bands of sheep were prevalent. Contemporary grazing pressure is not necessarily more intense than pre-settlement conditions. Lewis reported observing vast numbers of buffalo along the rivers in 1806 while traveling through the Dearborn-Sun area, including "not less than 10,000 buffalo" within a two-mile radius near the Sun River confluence with the Missouri. It should be recognized that interpretations of "unimpaired" riparian condition necessarily have a somewhat short-sighted perspective relative to historical "reference" conditions.

With this caveat, interpretation of "unimpaired" or reference riparian characteristics in the following discussion is generally a spatial comparison between "least impaired" reaches (i.e., maximum observed riparian coverage) vs. "impaired" reaches (i.e., areas that show evidence of conversion to agricultural uses or elevated grazing pressure). A description of selected features of the riparian corridor is presented on a stream-by-stream basis in the following sections.

The riparian buffer width was estimated by measurement from 1995 aerial photos and is reported for each of the study reaches. Riparian buffer width was measured as the distance that natural riparian vegetation extended from the streambank across the floodplain. Three classes of vegetation were delineated and the percent cover of each was reported for each of the study reaches. The vegetative community types included coniferous/deciduous tree, woody shrub, herbaceous, and bare ground.

Finally, a qualitative assessment of the integrity of the riparian buffer was conducted. For the purposes of this analysis, buffer integrity was ranked as good, fair, or poor. A "good" ranking represented a natural riparian vegetation community that extends uninterrupted from the edge of the active stream channel to the apparent topographic extent of the floodplain. A "fair" ranking represented a riparian buffer that showed evidence of possible vegetation alterations from grazing or other land use, but was generally intact along the stream channel. A "poor" ranking represents a natural riparian vegetation community that was restricted to the immediate proximity of channel margins, and/or a riparian buffer with obvious evidence of riparian harvest or conversion from a natural vegetation community to agriculture or impervious surfaces. In general, these rankings could be equated to "fully functioning, functioning at-risk, and non-functioning" type classification.

It should be noted that the aerial assessment techniques applied in this study are not adequately sensitive to detect all potential impacts to the riparian vegetative community. For example, the potential deleterious effects of low intensity or moderate grazing would not likely be detectable. Grazing impacts would likely only be noted in relatively extreme cases. Nonetheless, a "poor"

ranking clearly raises a “red flag” that the condition of the riparian corridor may be limiting water quality and a “good” ranking likely eliminates the potential concern.

Dearborn Mainstem

Riparian vegetation was primarily open stands of deciduous cottonwood type (6 to 33% coverage), with extensive areas of herbaceous understory (30-64% coverage) and woody shrub components (19-39% coverage) (**Table 3-2**).

Table 3-2 Dearborn Mainstem Riparian Vegetation Features

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
DR1	45	16	19	56	34	10
DR2	42	19	27	49	46	5
DR3	43	6	25	64	31	5
DR4	46	12	27	60	39	1
DR5	72	33	22	41	55	5
DR6	136	11	39	30	50	20

Although tree components were not the dominant vegetation component for the Dearborn mainstem, the overall coverage was good relative to the site potential. Riparian vegetation generally appeared to be in a seral state with multiple age classes of Cottonwood in active alluvial reaches (e.g. reach DR3). Upper reaches DR4, DR5, and DR6 had increasing amounts of coniferous overstory relative to deciduous Cottonwood.

Average riparian buffer width was fairly constant, ranging from 42 to 48 feet in reaches DR1 to DR4. Upper reaches DR5 and DR6 showed progressively greater riparian buffer widths (72 and 136 feet, respectively). This riparian buffer width appeared low relative to channel width (100 feet), but it should be noted that floodplain extents were limited by topographic features in many locations. Microsite factors (e.g. floodplain elevation, aspect, shading, etc.) also played an important role in vegetation distribution.

Representative photos for each Dearborn Mainstem Reach are found in **Figures 3-3 to 3-8**.

Figure 3-3. Dearborn Reach DR1



Figure 3-4. Dearborn Reach DR2



Figure 3-5. Dearborn Reach DR3



Figure 3-6. Dearborn Reach DR4



Figure 3-7. Dearborn Reach DR5



Figure 3-8. Dearborn Reach DR6



Shade provided by riparian vegetation to the stream channel was very limited on all reaches of the Dearborn mainstem. This resulted in part from low to moderate tree densities and canopy coverage, but also because tree heights and offset from the channel resulted in minimal shade projected to the water surface (e.g. **Figure 3-3**). Channel widths exceeding 100 feet limited effective shading potential from even mature Cottonwood stands adjacent to the river. The majority of shade to the Dearborn mainstem was related to topographic influences (see **Figures 3-3, 3-4, 3-7**).

Impervious/urban impacts on the mainstem of the Dearborn were infrequent and were limited to isolated road crossings and channel modifications. Bare ground or disturbed areas were present as gravel bar deposits or rock formations. Bare ground was largely unrelated to anthropogenic influences. Bare ground was especially characteristic of the braided reach in DR6 (20%).

Potential reference conditions for riparian vegetation in the Dearborn mainstem were difficult to establish based on clear delineation of pristine or un-impacted reach locations within the watershed. Review of historic aerial photographs and 2003 aerial reconnaissance did not suggest that reach-specific or localized grazing pressure had resulted in riparian impairment over most of the Dearborn. Upstream and downstream comparisons of adjoining reaches did not generally indicate any localized impairment to riparian condition or coverage related to human influence. Conversion of riparian communities to cropland or pasture was not characteristic of any reach of the Dearborn mainstem except for reach DR3. Reach DR3 showed some impacts from loss of riparian vegetation. Elsewhere in the Dearborn mainstem, human influence appeared minimal. Existing conditions likely represent relatively unimpacted vegetation characteristics. Much of the Dearborn mainstem is relatively inaccessible with a small, confined floodplain not well-suited to agricultural uses. This may account for the apparent low level of human impacts.

Dearborn Middle and South Fork

The distribution of riparian vegetation components in the Middle and South Forks is found in **Table 3-3** and is discussed in the subsequent sections separately for each stream reach.

Table 3-3 Riparian Vegetation Features

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
SF1	28	3	49	46	52	2
SF2	61	18	31	51	49	<1
MF1	78	4	37	59	40	1
MF2	36	11	6	76	16	8

Dearborn South Fork

Riparian vegetation in lower Reach SF1 was characterized by isolated stands of deciduous cottonwood (3%) with extensive areas of herbaceous understory (46%) and woody shrub components (49%) (**Table 3-3**). Upper reach SF2 was mixed stands of deciduous cottonwood or conifers (18%) with extensive areas of herbaceous understory (51%) and woody shrub

components (31%). Tree and woody shrub species increased towards the headwaters, and the upper portions of reach SF2 transitioned to a dominant coniferous overstory. Average riparian buffer width was 28 feet in reach SF1 and 61 feet in SF2.

Impervious/urban impacts on the South Fork of the Dearborn were infrequent, and were limited to isolated road crossings and channel modifications. Bare ground or disturbed areas were present as gravel bar deposits and were related to floodplain/land use in some cases.

Figures 3-9 and 3-10 contrast the ‘good’ and ‘poor’ riparian conditions for the South Fork of the Dearborn in the lower reach SF1. Woody species were predominately shrub/willow in ‘good’ reaches. Loss of riparian corridor due to conversion to agricultural uses resulted in reduced riparian buffer widths in many locations.

Figure 3-9. Central Portion of South Fork SF1 ‘Good’



Figure 3-10. Central Portion of South Fork SF1 ‘Poor’



The headwaters portion of the South Fork SF2 was primarily coniferous forest and did not show any significant influence from anthropogenic activities (**Figure 3-11**). Portions of the central and lower section of South Fork reach SF2 appeared to reflect the impacts of logging and riparian vegetation clearing (**Figure 3-12**). The aerial assessment could not determine whether grazing also impacted riparian coverage in this reach.

Figure 3-11. Upper Portion of South Fork SF2 ‘Good’

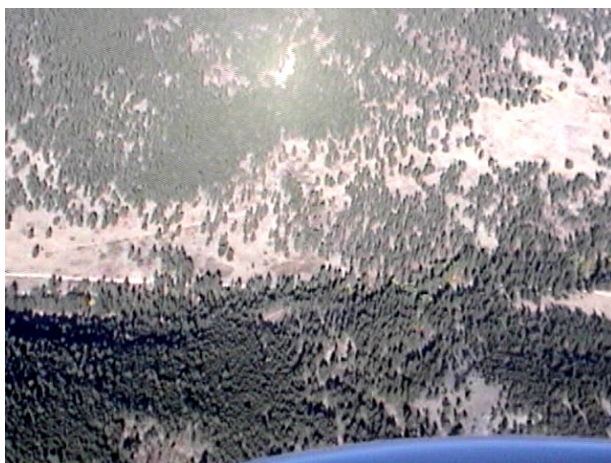


Figure 3-12. Lower Portion of South Fork SF2 ‘Poor’



Assessment of riparian vegetation impacts indicated that approximately 50% (20,593 feet) of riparian corridor was rated “poor” in lower reach SF1 (**Table 3-4**). An additional 29% (12,042 feet) was considered “fair”, and 21% (8,725 feet) was in “good” condition. Cropland and conversion to pasture accounted for riparian impacts. Locations of reaches coded by impact are found in **Appendix E**.

Table 3-4. Riparian Vegetation Impact on the Dearborn South Fork (SF1)

Impairment Status	Length	(%)
Good	8,725	21%
Fair	12,042	29%
Poor	20,593	50%
Total	41,361	100%

The upper reach of the South Fork SF2 showed post-1995 impacts from logging/riparian clearing along 5910 feet of channel. This resulted in a “poor” rating for this segment of the reach, although overall the headwaters were in “good” condition relative to site potential.

Vegetation assessment for the South Fork indicated that riparian coverage was sub-optimal in the lower reach SF1 and had significant conversion to herbaceous vegetation types. Riparian vegetation was lacking in woody shrub and tree components and was not in optimal condition relative to site potential. The upper reach SF2 had limited impacts from riparian clearing.

Dearborn Middle Fork

Riparian vegetation in lower reach MF1 was characterized by isolated stands of deciduous cottonwood (4%) with extensive areas of herbaceous understory (59%) and woody shrub components (37%) (**Table 3-3**). Upper reach MF2 was mixed stands of deciduous cottonwood or conifers (11%) with extensive areas of herbaceous understory (76%) and woody shrub components (6%). Tree and woody shrub species increased towards the headwaters, and the upper portions of reach MF2 transitioned to a dominant coniferous overstory. Vegetation coverage values were biased in reach MF2 because the aerial assessment focused on the lower end with more human impacts. Average riparian buffer width was 78 feet in reach MF1 and 36 feet in MF2.

Impervious/urban impacts on the Middle Fork of the Dearborn were generally limited to isolated road crossings. Bare ground or disturbed areas were present as gravel bar deposits and were related to land use/riparian vegetation loss in some locations.

Figures 3-13 to 3-15 contrast ‘good’ and ‘poor’ riparian conditions for the Middle Fork in the lower reach MF1. Woody species in the lower reach of the Middle Fork (MF1) were primarily woody shrubs. Tree components were not a significant part of the overall riparian coverage in ‘good’ reaches (**Figure 3-13**). Extensive clearing of riparian vegetation was apparent in the lower reach of the Middle Fork (**Figures 3-14 and 3-15**). The upper reach MF2 in the headwaters of the Middle Fork was mainly coniferous forest and was not significantly impacted by land use (**Figure 3-16**). Encroachment on riparian vegetation by Highway 200 was minimal except in a short section at the lower end of reach MF2.

**Figure 3-13. Middle Fork Dearborn (MF1)
‘Good’ Reach**



**Figure 3-14. Middle Fork Dearborn (MF1)
‘Fair’ Reach**



**Figure 3-15. Middle Fork Dearborn (MF1)
‘Poor’ Reach**



**Figure 3-16. Middle Fork Dearborn (MF2)
Reach**



Assessment of riparian vegetation impacts indicated that approximately 65% (20,593 feet) of riparian corridor was rated “poor” in lower reach MF1 (**Table 3-5**). An additional 29% (12,042 feet) was considered “fair”, and 21% (8,725 feet) was in “good” condition. Cropland and conversion to pasture accounted for riparian impacts. Locations of reaches coded by impact are found in **Appendix E**.

Table 3-5. Riparian Vegetation Impact on the Dearborn Middle Fork (MF1)

Impairment Status	Length	(%)
Good	9,743	29%
Fair	1,837	7%
Poor	21,286	65%
Total	32,886	100%

Overall, riparian vegetation in MF1 was lacking in deciduous tree and woody shrub components and was not in optimal condition relative to site potential. The headwaters reach MF2 appeared to be in good condition with a full complement of conifer/deciduous overstory in most areas except for a short section in the lowermost portions near Highway 200.

Flat Creek

Vegetation metrics for Flat Creek indicated that riparian tree and woody shrub coverage was extremely low for most reaches. Tree components were less than 1% in all reaches except downstream reach FC1 (9%). Overall, woody shrubs comprised about 21% of the riparian corridor (**Table 3-6**), and herbaceous species averaged 77%.

Table 3-6 Riparian Vegetation Characteristics on Flat Creek

Reach	Riparian Buffer Width (ft)	Vegetation Type (% of reach)				
		Con/Dec (%)	Woody Shrub (%)	Grass/Sedge (%)	Total Woody (%)	Bare Ground/ Disturbed (%)
FC1	47	9	12	79	21	0
FC2	61	<1	35	64	35	<1
FC3	78	<1	21	77	21	2
FC4	36	<1	4	93	4	2

The lowermost reach FC1 had the highest frequency of tree components, although herbaceous species were the dominant vegetation type (**Figure 3-17**). Average riparian buffer width was 47 feet in reach FC1 and was composed of about 79% herbaceous vegetation and 21% mixed conifer/deciduous and woody shrubs.

Vegetation in the upstream reaches FC2, FC3, FC4 was largely herbaceous, with lesser amounts of remnant and decadent woody shrub species. Riparian buffer width (36 to 78 feet) was low in these upper reaches of Flat Creek relative to potential (**Figures 3-19 to 3-21**).

Impervious/urban impacts on Flat Creek were associated with road crossings and channel modifications. Bare ground or disturbed areas were relatively localized and had minor impacts to riparian vegetation.

Flat Creek would not be expected to support a significant Cottonwood overstory given the relatively arid plains location, channel type, and fine-grained floodplain substrate. Willow, snowberry and other shrubs would be expected to be the dominant riparian component in this geologic setting. It should be noted that less visible forms of woody species (e.g. sandbar willow) were not easily identified with aerial assessment. As a result, woody shrub components may be underestimated. Nevertheless, it is apparent that the high proportion of herbaceous vegetation likely does not represent optimal conditions for reaches FC2, FC3, and FC4. Flat Creek would potentially support a much more extensive woody shrub component especially given the augmented flow regime. The entire length of Flat Creek was considered to be in the “poor” category for riparian impacts.

**Figure 3-17. Flat Creek Reach FC1
Unconfined Lower Reach**



**Figure 3-18. Flat Creek Reach FC1
Confined Lower Reach**



Figure 3-19. Flat Creek Reach FC2 Reach



Figure 3-20. Flat Creek Reach FC3 Reach



Figure 3-21. Flat Creek Reach FC4 Reach



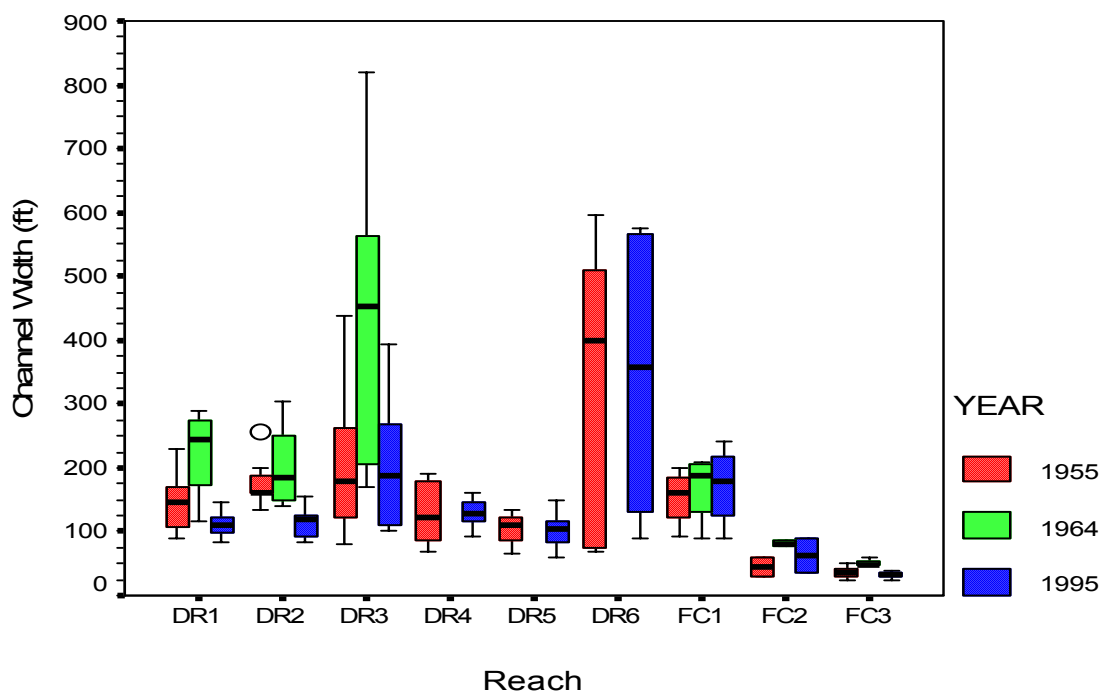
3.3 Temporal Changes in Channel Condition

A review of historic aerial photos was undertaken to evaluate changes in channel conditions over time. Aerial photo coverage for 1955, 1964, and 1995 was limited to the central portion of the study area on the mainstem of the Dearborn and portions of Flat Creek. Channel geometry including active channel width, stability, and riparian coverage were assessed and compared for those areas with coverage for the time period. The full set of coverage for the Dearborn reaches including 1955, 1964, and 1995 flights was available for reaches DR1, DR2, and DR3. The Flat Creek reaches FC1, FC2, FC3 also had coverage for these years. Dearborn Reaches DR4, DR5, and DR6 had coverage for 1955 and 1995 only, and no coverage was available for the Middle and South Forks of the Dearborn.

3.3.1 Channel Widths

Channel width was measured as the distance between the vegetative indicators that defined bank margins. In this analysis, topographic limits such as terraces, hillsides, and rock walls also helped define channel extents. Channel width approximates bankfull width in many cross sections but would exceed true bankfull measures especially for the 1964 measurements. For example, the measures of width in 1964 are larger than the geomorphic bankfull width because they include large expanses of gravel bar deposits and disturbed floodplain surfaces. Greatly increased width following the 1964 flood reflects loss of vegetation within the bankfull floodplain in addition to probable enlargement of channel cross section.

Figure 3-22. Estimated Channel Width in the Dearborn Planning Area in 1955, 1964, and 1995



In general, measurements showed that channel widths increased substantially following the 1964 flood, and that 1995 widths were comparable to pre-flood (1955) values (**Figure 3-22**).

Channel response to the 1964 flood resulted in significantly increased channel widths. In Dearborn reach DR1, channel width increased about 50%, from a 1955 value of 146 feet to 223 feet post-flood (**Table 3-7**). The Dearborn reach DR2 increased about 17% from a 1955 value of 176 feet to 205 feet post-flood, and reach DR3 nearly doubled in width to 429 feet. By 1995 these reaches had returned to pre-flood channel widths. DR1 and DR2 were narrower in 1995 compared to 1955. For reaches DR4 and DR5, 1964 data was not available. However, 1955 and 1995 measures show channel widths to be nearly identical.

Table 3-7. Temporal Changes in Channel Width

Reach	Channel Width (ft)		
	1955	1964	1995
DR1	146	223	111
DR2	176	206	117
DR3	206	429	203
DR4	129	NA	130
DR5	104	NA	106
DR6	342	NA	346
FC1	153	169	172
FC2	45	81	62
FC3	37	52	33

Flat Creek reaches FC2 and FC3 also showed significant increases in channel width post-1964 flood. FC1 appeared relatively unaffected with channel widths increasing only slightly in 1964.

To state the obvious, a major decrease in channel stability occurred along with channel width increases after the 1964 flood. No metrics were calculated for bank erosion to demonstrate this point. Recovery of channel widths in 1995 to dimensions near (or less than) 1955 values indicates a strong trend for channel recovery following the 1964 flood. It is reasonable to assume that rebuilding of floodplain soils on exposed gravel deposits and re-establishment of climax floodplain vegetation communities is still continuing in the present day. Full recovery from the 1964 flood event has been gradual in many alluvial channels along the Rocky Mountain front. Exposed gravel floodplain surfaces are widespread in the portions of the Teton River, Birch Creek, and elsewhere in the area.

3.3.2 Temporal Changes in Canopy Coverage

A review of historic aerial photos was undertaken to evaluate changes in riparian vegetation over time. Conifer/deciduous tree, woody shrub, herbaceous, and bare ground classes were quantified. Aerial photo coverage for 1955, 1964, and 1995 was for the Dearborn, and portions of Flat Creek. The full set of coverage for the Dearborn reaches including 1955, 1964, and 1995 flights was available for reaches DR1, DR2, and DR3. The Flat Creek reaches FC2 and FC3 also had coverage for these years. Dearborn Reaches DR4, DR5, and DR6 had coverage for 1955 and 1995 only, and no coverage was available for the Middle and South Forks of the Dearborn.

Dearborn Mainstem

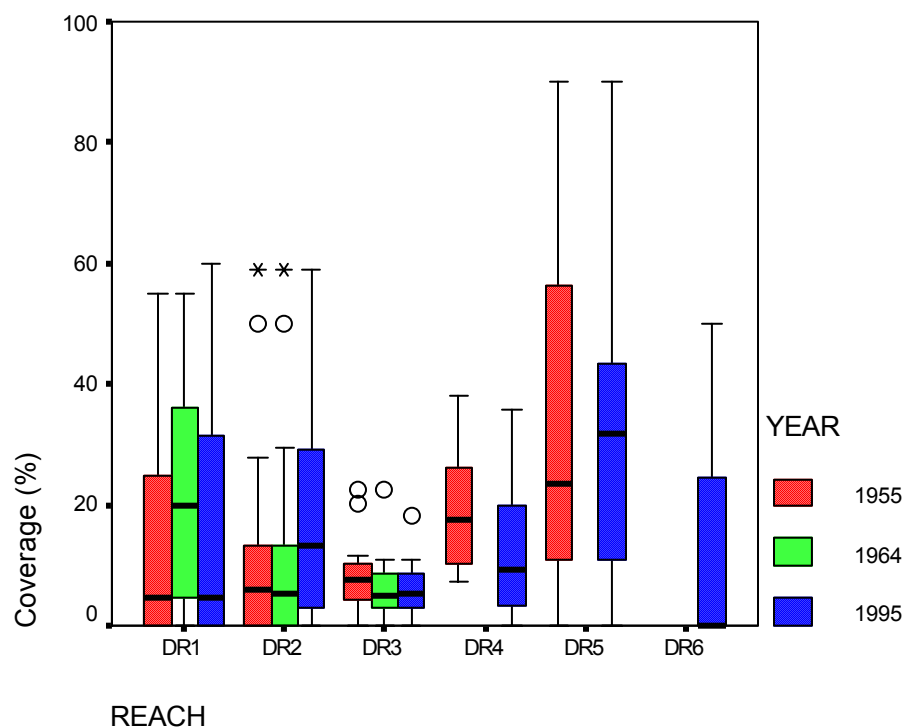
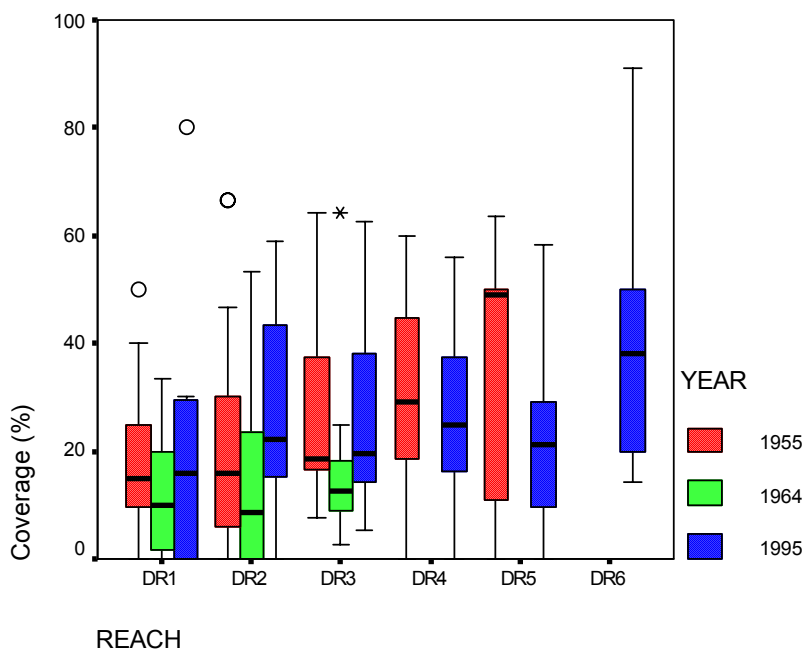
Changes in riparian coverage and composition were variable in the Dearborn mainstem (**Table 3-8**). The composite of conifer/deciduous trees and woody shrubs suggested that woody vegetation was unchanged in reach DR1 from 1955 to 1995. Dearborn reach DR2 decreased from 34% in 1955 to 27% in 1964, and increased to 46% in 1995. Reach DR3 also decreased from 1955 to 1964 (34% to 23%), and increased to 31% coverage in 1995. Reaches DR4 and DR5 both showed a 10-15% decrease in woody vegetation from 1955 to 1995. No data was available for 1964 in the upper reaches of the Dearborn.

Table 3-8. Temporal Changes in Tree/Woody Shrub Canopy Coverage

Reach	Canopy Coverage (%)		
	1955	1964	1995
DR1	33.6	34.7	34.1
DR2	33.9	26.8	46.4
DR3	34.0	22.5	30.5
DR4	49.6	NA	38.9
DR5	69.3	NA	54.6
DR6	NA	NA	49.5
SF1	NA	NA	51.8
SF2	NA	NA	48.7
MF1	NA	NA	40.4
MF2	NA	NA	16.3
FC1	NA	NA	20.9
FC2	30.5	30.5	35.0
FC3	19.9	18.3	21.4
FC4	NA	NA	4.3

Boxplots of individual riparian vegetation components are shown in (**Figures 3-23 to 3-26**). Conifer and deciduous tree coverage in reach DR1 was similar in 1955 and 1995, and was significantly higher in 1964 (**Figure 3-23**). Reach DR2 was similar in 1955 and 1964, and increased in 1995. Reach DR3 showed little change in tree coverage from 1955 to 1995. Reach DR4 decreased from 1955 to 1995, and reach DR5 increased tree coverage over the same time period. No historic data was available for reach DR6.

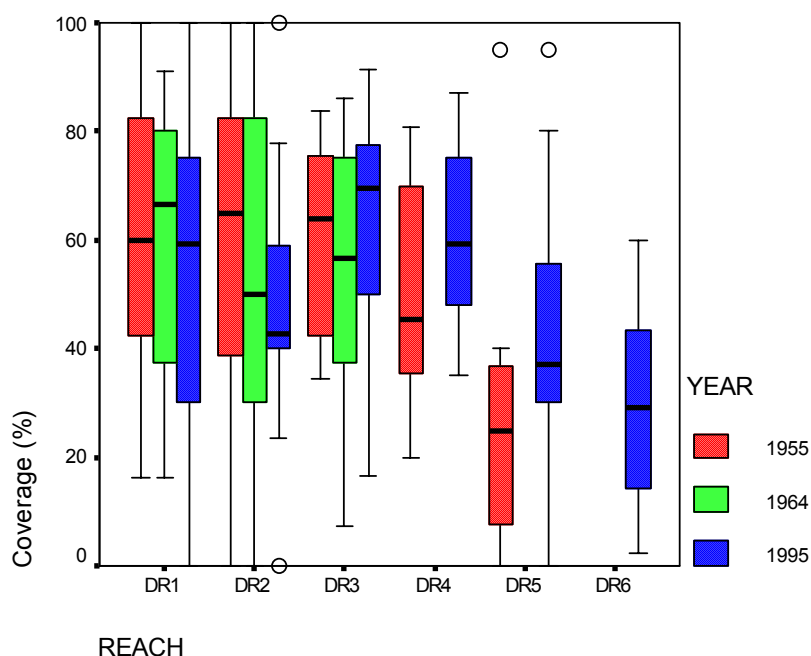
Overall, woody shrub coverage tended to increase in the upstream direction, with median values of 10-20% in the lower reaches, and values of 25-50% in the upper reaches. Shrub component was generally similar in 1955 and 1995 for most reaches, with the exception of reach DR5 that showed a decrease in woody shrub coverage. Trees increased in this reach over the same time period.

Figure 3-23. Conifer/Deciduous Coverage in the Dearborn Mainstem in 1955, 1964, and 1995**Figure 3-24. Woody Shrub Coverage in the Dearborn Mainstem in 1955, 1964, and 1995**

Overall, herbaceous coverage tended to increase in the downstream direction with median values of 60-70% in the lower reaches, and values of 20-40% in the upper reaches (**Figure 3-25**).

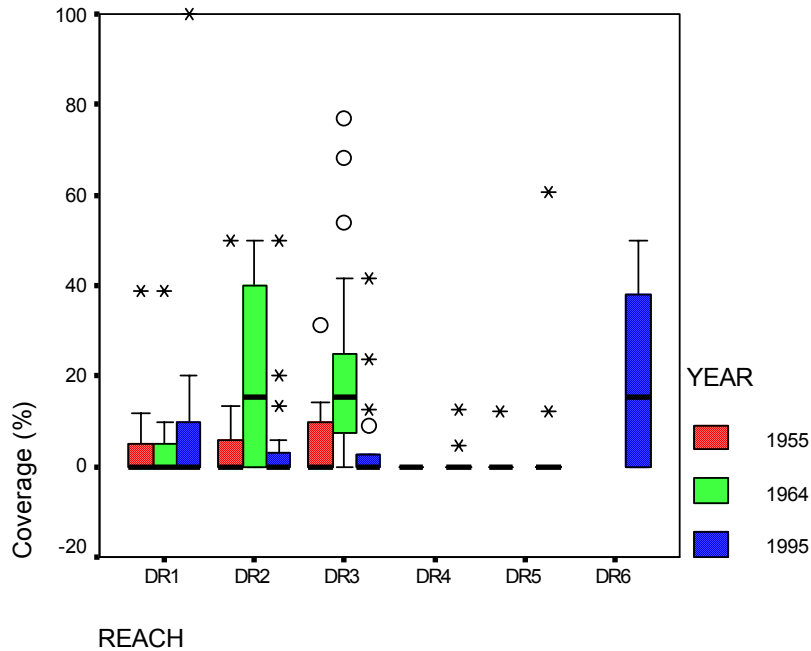
Herbaceous coverage in reach DR1 was similar in 1955 and 1995, and showed a small increase in 1964. Reach DR2 herbaceous coverage decreased from 1955 to 1995, and showed corresponding increases in trees and shrubs. Reach DR3 showed a drop in herbaceous coverage in 1964, and was slightly higher in 1995 than 1955. Reaches DR4 and DR5 showed significant increases in herbaceous coverage from 1955 and 1995. Decreases in shrub coverage were also noted during this period. No 1955 or 1964 data was available for reach DR6.

Figure 3-25. Herbaceous Coverage in the Dearborn Mainstem in 1955, 1964, and 1995



Overall, bare ground was a minor component in riparian areas, generally less than 10% (**Figure 3-26**). Significant increases in disturbed, bare ground was observed following the 1964 flood in DR2 and DR3. This increase in disturbed ground returned to pre-flood levels in 1995.

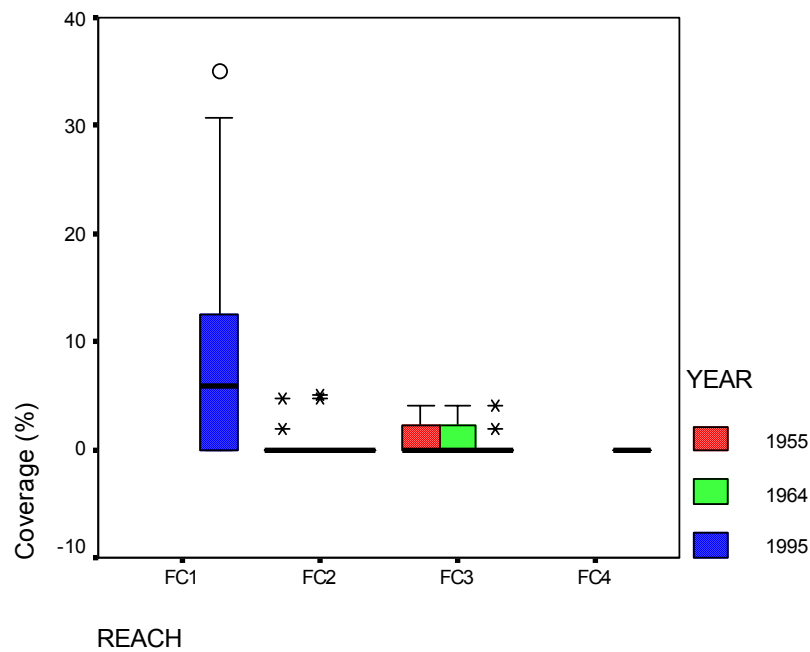
Figure 3-26. Bare Ground in the Dearborn Mainstem in 1955, 1964, and 1995



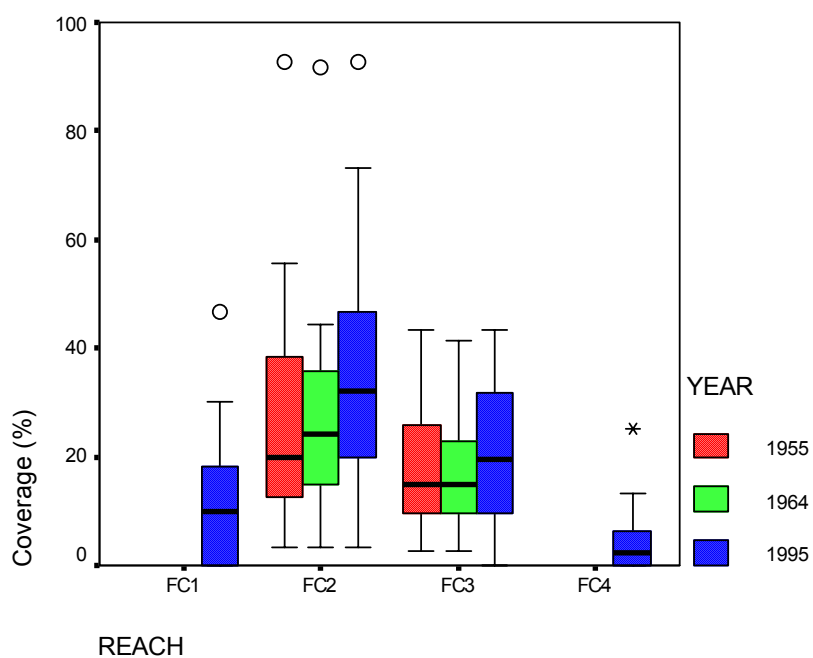
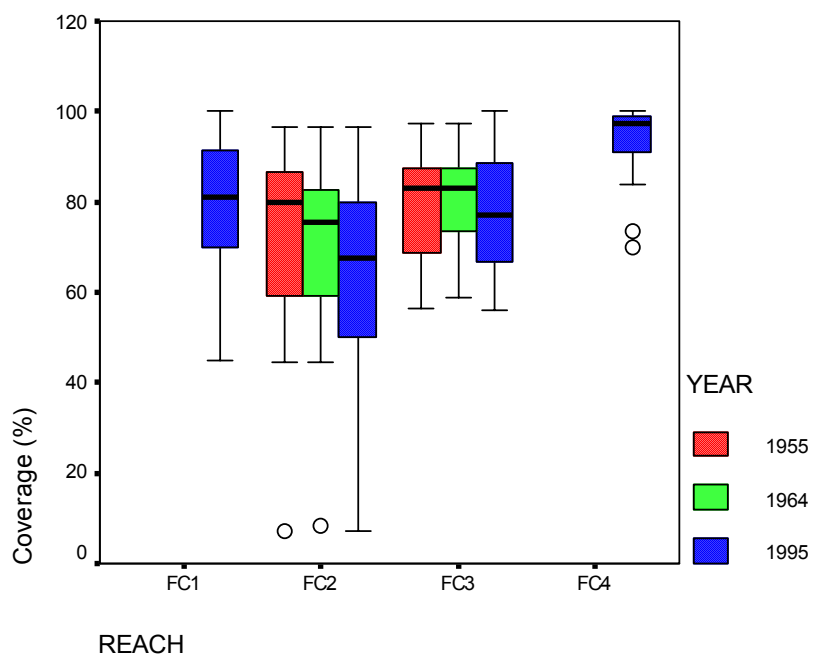
In summary, the lower three reaches of the Dearborn (DR1, DR2, and DR3) generally showed similar or greater tree and woody shrub coverage in 1995 as compared to 1955. With the exception of reach DR1, tree coverage as a proportion of total riparian vegetation did not change significantly as a result of the 1964 flood. Woody shrub coverage did tend to decrease in these reaches in 1964, but returned to pre-flood (1955) levels by 1995.

Flat Creek

Aerial coverage was available for 1955, 1964, and 1995 for Flat Creek reaches FC2 and FC3. Tree coverage in Flat Creek was generally minimal with the exception of FC1 (9%). No significant changes in tree coverage were apparent for Flat Creek reaches FC2 and FC3 from 1955 to 1995.

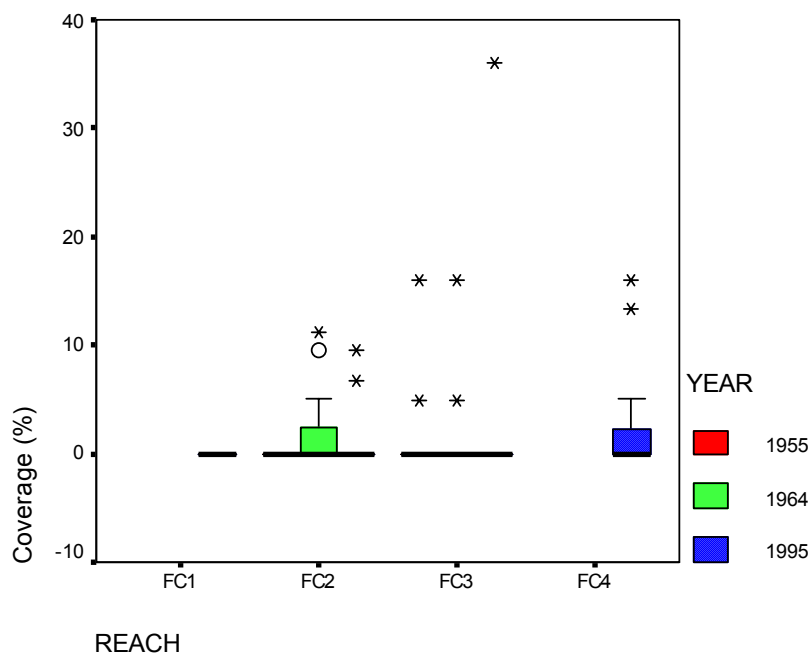
Figure 3-27. Conifer/Deciduous Coverage in Flat Creek in 1955, 1964, and 1995

The proportion of woody shrub coverage tended to increase in Flat Creek reach FC2 and FC3 from 1955 to 1995. The increase amounted to 5 to 10% greater woody coverage in 1995 relative to 1955 (**Figure 3-28**). Herbaceous coverage also tended to decrease over the same time period reaches FC2 and FC3 (**Figure 3-29**). No historical coverage was available for reaches FC1 and FC4.

Figure 3-28. Woody Shrub Coverage in Flat Creek in 1955, 1964, and 1995**Figure 3-29. Herbaceous Coverage in Flat Creek in 1955, 1964, and 1995**

Bare ground was infrequent in Flat Creek and amounted to less than 1% overall. A slight increase in bare ground was observed in 1964 in reach FC2, but was otherwise unchanged from 1955 to 1995.

Figure 3-30. Bare Ground in Flat Creek in 1955, 1964, and 1995



In summary, the central reaches of Flat Creek appeared to show an increase in woody shrub coverage and a decrease in herbaceous coverage from 1955-1995.

3.4 Sediment Source Areas

Potential sediment source areas were inventoried based on 1995 digital orthophotos and the results of 2003 aerial reconnaissance. Sediment sources inventoried included bank erosion, mass failure of terraces/slopes, headcutting from tributary drainages, incised reaches, and delivery from upland sources.

On the mainstem Dearborn and portions of Flat Creek an additional review of historic aerial photos was undertaken to evaluate changes in sediment sources over time and to help interpret trends. Aerial photo coverage for 1955, 1964, and 1995 was limited to these areas and was not conducted on other waterbodies in the project area.

3.4.1 In-Channel Sources

Overall, sediment sources in the Dearborn planning area were predominately derived from in-channel scour and fill processes. The bank stability (**Section 3.2.1**) assessment showed that significant sediment sources exist in portions of most stream segments. Eroding banks were classified as either “natural” or “anthropogenic” based on professional judgment considering factors such as adjoining land use, apparent channel modifications, vegetation alterations, and

visual comparison to potential channel characteristics of up and downstream reaches. Length of eroding banks was quantified for the lower Middle Fork reach MF1 and Flat Creek (all reaches).

Dearborn Mainstem

Very little evidence of channel or riparian modification was apparent on the mainstem of the Dearborn based on aerial assessment. Much of the channel is located in deeply incised terrain with a confined floodplain. No cultivated farmland is present within the floodplain of the Dearborn mainstem except in reach DR3. Potential human impacts in most of the Dearborn would be largely limited to riparian vegetation alterations associated with grazing pressure and bank trampling. Review of aerial photographs and 2003 aerial reconnaissance did not indicate that any obvious grazing or land use conversion had impacted riparian or bank conditions in the Dearborn mainstem overall. Pre-1955 conditions are unknown, and the possibility exists that more intensive historical grazing (e.g. intensive sheep and cattle grazing) could have altered riparian communities to some extent. This issue cannot be addressed directly in this study.

Examination of historic photos as well as upstream-downstream comparisons did not show any strong localized riparian modification, associated bank instability, or grazing-related sediment sources with the exception of reach DR3. Conversion of riparian areas to hay/pasture may play a role in bank stability within portions of the upper 2.5 miles in this reach. Reach DR3 was an unconfined C4 channel which would be expected to have significant natural erosion and depositional processes. Sediment in the Dearborn mainstem appears to be derived almost entirely from natural alluvial channel processes.

Middle Fork

The Middle Fork of the Dearborn showed little influence of anthropogenic, in-channel sediment sources in the headwaters (MF2). This section of the channel is situated in deeply dissected, forested terrain and no significant channel or riparian modifications were present. Logging activity and road systems in the headwaters did not appear to contribute elevated quantities of sediment. Highway 200 has the potential to contribute sediment from cut/fill slopes and applied road sand. However, the aerial assessment did not show any apparent delivery of sediment from the road to the Middle Fork. Long delivery distance from the road to the channel is likely to limit sediment contribution in most locations. A possible pathway for road runoff was investigated on the ground but did not appear to be a source of significant sediment delivery to the channel. Spring snowmelt does have the potential to deliver road sand to the Middle Fork, but a comprehensive field investigation was beyond the scope of this study. Evaluating this potential source of sediment would require additional field work to determine if concentrated flow pathways are present.

The lower reach of the Middle Fork (MF1) showed evidence of channel instability related to land use/riparian modification for agriculture. In-channel sediment sources were present due to human-induced channel instability in some areas. An estimate of eroding bank lengths was made from the 1995 digital orthoquads and interpretation of the 2003 aerial video flight (**Table 3-9**). Bank erosion was classified into “high”, “moderate”, and “low” categories. These rankings are intended to correspond to probable Rosgen Bank Erosion Hazard Index (BEHI) values. Banks in the high and moderate categories were evaluated to determine if anthropogenic factors were a contributing factor to bank instability. Human land use impacts were assumed if

riparian conversion to agriculture or grazing effects on streambanks appeared to be a significant factor in bank stability. An evaluation of bank stability in adjoining upstream and downstream reaches assisted in this interpretation.

Table 3-9 Bank Erosion, Middle Fork Reach MF1

Category	Length (ft)	%	% Anthropogenic related
High	3486	10.6	45%
Moderate	11609	35.3	40%
Low	17791	54.1	NA
Total	32886	100.0	NA

Approximately 45% of eroding banks (1,569 feet) in the high category were associated with human related impacts. In several areas, eroding terraces were natural or not primarily related to human impacts. For example, a natural stream position along the valley margin can result in an eroding terrace feature that is mostly unrelated to adjoining land use.

Eroding banks in the moderate category associated with land use impacts totaled 4640 feet, accounting for 40% of eroding banks in this category. The remaining 60% of banks in the moderate category were not directly associated with land use impacts and represented natural, relatively unimpaired bank conditions for this channel type (Rosgen C4). The entire reach of the lower Middle Fork (MF1) has experienced some level of grazing pressure and conversion of riparian vegetation to agricultural uses. Drawing a clear distinction between human-impacted and natural banks from an aerial assessment was difficult. Additional challenges include the diffuse nature of possible grazing impacts and the potential for “response” reaches to reflect upstream impairment (e.g. increased sediment load) rather than immediate land use impacts. The value of 40% (4640) feet of streambank in the moderate category is intended to represent a conservative estimate of stream length directly impacted by land use activities.

South Fork

The headwaters of the South Fork (SF2) were steep, forested terrain and did not show evidence of anthropogenic sediment sources or accelerated bank erosion. The lower reach of SF2 had a 5900 foot segment of riparian area that was cleared/logged and some increases in sediment yield may be possible. Channel stability appeared to be impacted to some extent and additional investigation on the ground may be warranted.

The lower reach (SF1) of the South Fork had several miles where the riparian corridor had been converted to agricultural purposes (pasture and grazing). Some impacts to bank stability and channel shading were apparent but were generally of a diffuse nature. A BEHI assessment was not completed and additional field assessment may be required to evaluate these areas as potential sediment sources.

Flat Creek

Flat Creek has significant anthropogenic sources of sediment related to the altered flow regime and related channel adjustments. Diverted irrigation water greatly exceeds pre-development flow rates and results in an enlarged channel cross section and actively eroding banks. Grazing and conversion of riparian areas to pasture and cropland have also contributed to sediment impairments.

Flat Creek serves as an irrigation conveyance with flows exceeding 70 cfs diverted into the channel from the Dearborn mainstem. Prior to diversion of water the channel was likely a stable, meandering E type channel (transitioning to C) with a riparian zone composed predominately of willow-woody shrub species, and possibly lesser amounts of Cottonwood in the lower reaches. Sediment yield from eroding streambanks would have been relatively low compared to current conditions. Auchard Creek, a small tributary to the Dearborn (and parallel to Flat Creek), shows good channel stability and few actively eroding banks.

Present day channel morphology and channel adjustments have significantly increased sediment yield from Flat Creek. No pre-modification or reference data were available; however, it is likely that the majority of increased sediment yield from eroding banks on Flat Creek can be attributed to land use impacts. Loss of beaver from the system may also contribute to channel alterations including downcutting and bank erosion.

An estimate of eroding bank lengths was made from the 1995 digital orthoquads and interpretation of the 2003 aerial video flight (**Table 3-10**). Bank erosion was classified into “high”, “moderate”, and “low” categories. These rankings are intended to correspond to probable Rosgen Bank Erosion Hazard Index (BEHI) values.

Table 3-10 Bank Erosion, Flat Creek

Reach/Category	Total Length (ft)	%	% Anthropogenic related
FC1			
High	4593	11.2	80%
Moderate	7259	17.7	60%
Low	29,158	71.1	
Total	41,010	100.0	
FC2			
High	3066	13.1	90%
Moderate	8635	36.9	90%
Low	11,701	50.0	
Total	23,401	100.0	
FC3			
High	3215	14.0	90%
Moderate	7074	30.8	90%
Low	12,678	55.2	
Total	22,967	100.0	
FC4			
High	7802	8.4	90%
Moderate	30,929	33.3	90%
Low	54,149	58.3	
Total	92,880	100.0	
Grand Total	32886	100.0	

In reach FC1, approximately 80% of eroding banks in the high category were associated with land use impacts totaling 3674 feet. Natural eroding terraces and hillsides not primarily related to land use accounted for 20% of eroding banks in the “high” category. Eroding banks in the moderate category associated with land use impacts totaled 4355 feet, accounting for 60% of

eroding banks in this category. Approximately 40% of banks in the moderate category were not directly attributable to land use impacts and represented natural variability for this channel type (Rosgen C4).

Reaches FC2, FC3, and FC4 showed similar distributions of eroding banks in each category. Banks in the high category ranged from 8.4 to 14% of total reach length and 90% of these banks were related to human impacts. Total length of impacted banks in the high category was 2759, 2894, and 7022 feet in reaches FC2, FC3, and FC4, respectively.

Banks in the moderate category ranged from 31% to 37% of total reach length. Like banks in the “high” category, 90% of the banks in the moderate category were associated with agricultural impacts and alterations related to increased flow in Flat Creek. Total length of impacted banks in the moderate category was 7771, 6366, and 27,836 feet in reaches FC2, FC3, and FC4, respectively.

Although values of 80-90% human impacted banks may appear to be an extreme number, it should be noted that extensive riparian conversion to pasture and cropland as well as grazing impacts were widespread in Flat Creek. Sustained summer irrigation flow greatly exceeds the natural hydrograph of Flat Creek. This increased flow from irrigation diversion appeared to be a significant factor in bank stability. As a result of these considerations nearly all bank erosion in the “high” and “moderate” categories was attributed to human impacts.

3.4.2 Mass Failure

Mass failure was an uncommon source for sediment within the Dearborn and tributaries. A single location on the Dearborn mainstem showed evidence of active mass failure in Reach DR6, and was related to natural processes. Shallow-seated slumps were located on unconsolidated parent material, and contributed sediment directly to the Dearborn mainstem in this location (**Figure 3-31**). Limited areas of dry ravel/rilling were present but infrequent on steep slopes adjacent to the active channel in Reach DR4 (**Figure 3-32**). These natural sources of sediment would be expected to contribute fines to the channel during extreme rainfall events and also during peak flow events that erode the toe of the slope.

Figure 3-31. Slumps in Dearborn Mainstem Reach 6



Figure 3-32. Dry Ravel/Rilling in the Dearborn Mainstem Reach 4



No anthropogenic related sources of mass failure or delivery of sediment to the Dearborn mainstem were observed. No mass failure was observed in the Middle or South forks of the Dearborn.

A significant major source of mass failure was sloughing of high banks along Flat Creek. This was considered under the bank erosion category of sediment sources since it is primarily related to fluvial action and bank stability.

3.4.3 Headcutting/Incised Reaches

Active headcutting and sediment delivery to listed reaches was not characteristic of small channels draining upland areas. No active gully formation was observed in either ephemeral or perennial tributaries. Vertical stability in tributaries was good, and headcut formation in rangeland did not appear to be a significant source of sediment in the Dearborn Planning Area.

A series of three gullies were observed along reach DR5 in the Dearborn mainstem (**Figure 3-33**). These gullies appeared stable and may be a remnant of heavy precipitation/surface runoff in the spring of 1964 or other intense rainfall events.

The majority of smaller drainages and tributaries to the Dearborn mainstem appeared to be vertically stable, and were not a significant source of sediment to the Dearborn (**Figure 3-34**). The Middle and South forks of the Dearborn did not show any significant sources of sediment from influent tributaries.

Incised channel conditions were observed in portions of Flat Creek and were most probably related to the increased flow regime of diverted irrigation water. Loss of beaver from Flat Creek may also contribute to apparent localized changes in base level.

Figure 3-33. Gullies in the Dearborn Mainstem Reach 5



Figure 3-34. Typical Smaller Contributing Drainages to the Dearborn Mainstem



3.4.4 Upland Sources

Upland sources did not appear to contribute appreciable quantities of sediment to the Dearborn mainstem or tributaries. Perennial and intermittent tributaries appeared stable, and rangeland did not show evidence of surface erosion, rilling, or other signs of accelerated soil loss due to anthropogenic influences. Forested headwaters were largely pristine and unroaded in the mainstem and South Fork of the Dearborn. The Middle Fork of the Dearborn had minor impacts from Highway 200 in the upper headwaters (in the ephemeral portion). Sediment contribution from cut/fill slopes and road sand from Highway 200 appeared to be minimal due to the long delivery distance to the channel.

Hogan Creek (Tributary to Flat Creek, above the listed reach) showed pronounced turbidity during the 2003 aerial survey (**Figure 3-35**). Sediment sources appeared to originate from channel incisement, exposed soils and relatively poor vegetation coverage in this drainage. Soils appeared to be fine-textured and relatively arid. No obvious anthropogenic influence appeared to account for turbid water originating from Hogan Creek, although grazing may contribute to sparse vegetation coverage. Several small impoundments (presumably for stockwater) on Hogan Creek likely limit the potential delivery of sand/silt fractions to Flat Creek (**Figure 3-36**). In addition, the relative loading of sediment from Hogan Creek is likely to be low due to the low elevation and runoff volume.

Upland sources of sediment in Hogan Creek warrant additional field investigation to establish whether they are a significant contributor to impairment in Flat Creek.

Figure 3-35. Hogan Creek, Tributary to Flat Creek Reach 4.



Figure 3-36. Upper Hogan Creek, Tributary to Flat Creek Reach 4.



3.5 Cultural Features

An inventory of cultural, anthropogenic channel modifications was undertaken using 1995 aerial photos and aerial reconnaissance in 2003 (**Table 3-11**). Overall, the main cultural feature was stream crossings including bridges and fords. Stream crossings did not appear to have any significant up or downstream impacts on channel function other than minor localized effects. Very little bank stabilization/rip-rap or channelization was apparent in the reaches studied and did not account for any significant impacts to channel morphology.

No impoundments were observed in the primary reaches studied, although a number of small stockwater impoundments were present in smaller tributary streams to Flat Creek (e.g. Hogan Creek). These impoundments are unlikely to contribute significantly to either thermal or sediment impairments to Flat Creek and may help sustain summer baseflows in some cases. Small impoundments in Hogan Creek may reduce sediment loading to Flat Creek though this influence is likely to be minimal based on contributing area and water yield for the drainage.

Diversion structures were present in the Dearborn mainstem (Dearborn Canal), South Fork (Gibson Renning Ditch), Middle Fork (4 diversions), and Flat Creek (multiple locations). An assessment of diversion rates/capacity was beyond the scope of this study, and additional field investigation may be warranted to determine the influence of these diversions on flow and thermal impairments.

No major anthropogenic point sources for sediment or temperature impairment were noted. The Milford Colony has several lagoons/holding ponds located along the riparian corridor of Flat Creek (**Figures 3-37, 3-38**). Water quality in these lagoons is unknown and potential impacts to Flat Creek could not be determined in this study. The possible influence of these features on water quality may warrant additional investigation, although the potential to affect sediment or thermal impairments is likely to be minimal.

Figure 3-37. Milford Colony



Figure 3-38. Milford Colony



Table 3-11 Cultural Features – Dearborn River

Reach	Rip-rap/other stabilization	Channelization	Impoundments	Instream Structures/ Diversions	Stream Crossings	Potential Water Quality Point Sources	Other (gravel pits, construction)
DR1	NA	NA	NA	NA	Train Bridge at Mouth Ford near pt. 3 Ford above pt. 5 Ford near pt. 11	NA	NA
DR2	NA	NA	NA	NA	NA	NA	NA
DR3	Minor rip-rap near bridge	NA	NA	Ditch near SF Mouth	Hwy 285 Bridge Small bridge nr pt. 2	NA	NA
DR4	NA	NA	NA	NA	Hwy 200 Bridge	NA	NA
DR5	NA	NA	NA		Bridge near pt. 16	NA	
DR6	250 ft at pt 13	NA	NA	Bean Ditch near pt 12 Dearborn Canal bl pt. 14	Bridge near pt. 8 Siphon out below pt. 6	NA	NA
SF1	NA	NA	NA	NA	Ford near mouth Bridge bl pt. 11 2 Bridges abv pt. 14 Bridge abv pt. 19	NA	NA
SF2	NA	NA	NA	Gibson-Renning ditch diversion nr pt 3	2 bridges nr pt 3 Bridge or ford blw pt 5? Bridge or ford abv SF-9 Bridge or ford between SF-10 and 11 Bridge or ford blw SF-10 Bridge nr SF-13	NA	NA
MF1	NA	NA	NA	2 Gillette ditch Borho Ditch diversion	Bridge nr pt 10 Bridge nr pt 17	NA	NA
MF2	Riprap by Hwy 200 blw MF-12 - 500ft	NA	NA	Nitch ditch Dueringer ditch	Hwy 200 bridge Bridge abv MF-10 Ford? Blw MF-14	NA	NA
FC1	NA	NA	NA	NA	NA	NA	NA
FC2	NA	NA	NA	NA	Ford nr pt. 15 Bridge-end of reach	NA	
FC3	Minor	NA	NA	Garino ditch Diversion Diversion a Hamilton ditch diversion between 11 and 12	Bridge and ford between pt 7 and 8 Ford between pt 21 and 22 Ford between pt 19 and 20	NA	NA
FC4	Minor	NA	Hogan Cr.	NA	NA	Milford Colony	NA

4.0 SUMMARY AND CONCLUSIONS

This study is based on an aerial reconnaissance conducted in October 2003 and the interpretation of historic aerial photographs from 1995, 1964, and 1995. Channel morphology, riparian condition, and source areas were evaluated to assess potential sources of impairment in the Dearborn planning area.

4.1 Potential Impairments

Dearborn Mainstem

The study indicated that anthropogenic influences have not substantially degraded the condition of riparian vegetation or channel function on most reaches of the Dearborn mainstem. No significant human impacts related to land use, conversion of riparian areas to pasture/cropland, or grazing were apparent except in reach DR3. Conversion of riparian areas to hay/pasture may play a role in bank stability within portions of the upper 2.5 miles in this reach. Most reaches of the mainstem had a small, confined floodplain that was relatively inaccessible and not well suited for agriculture. This probably explains the lack of human impacts to the channel and riparian community.

The 1964 flood had significant influence on channel stability and riparian vegetation in the Dearborn mainstem. Gravel bars, eroding banks and loss of riparian vegetation were apparent throughout much of the Dearborn in the post-flood aerial photos. Increased channel width and reduced riparian coverage were especially prevalent in alluvial reach DR3. Geologic structural constraints appeared to limit impacts from extreme flooding in other reaches. Riparian and channel conditions were generally comparable in 1955 and 1995, suggesting that the channel recovered from flood effects in the subsequent 41 years.

The deciduous cottonwood overstory in the Dearborn mainstem appeared to be in a seral state with multiple age classes of trees represented in many locations. This appeared to be related to natural fluvial processes rather than agricultural land use impacts with the exception of reach DR3. Shade provided by riparian vegetation did not appear to be substantial even in mature deciduous or coniferous riparian communities adjacent to the channel.

Sediment source areas were limited to natural processes including morphologically active channel segments, natural terraces and slopes, and natural bank erosion. Overall, land use and human impacts did not account for any significant increase in sediment sources or impairment. Reach DR3 had several locations with eroding banks that may be attributable to loss of riparian woody vegetation and impacts from agricultural uses.

Comparison of historic photos did not indicate any significant trend in human-related impacts to channel stability or riparian vegetation on the mainstem. Except for reach DR3, upstream and downstream comparisons also did not show any reach-specific impacts from human activities. In summary, the mainstem of the Dearborn appeared to be near full potential for riparian vegetation and channel/streambank stability given natural factors.

South Fork of the Dearborn

The South Fork of the Dearborn showed evidence of human impacts on riparian vegetation in both reaches studied. The upper reach SF2 was in good overall condition with a mature overstory of dominantly coniferous vegetation. A single 5910 foot segment of channel showed loss of riparian vegetation due to logging/riparian clearing that occurred after 1995. This resulted in loss of shade to the channel, but streambank stability appeared to be good overall.

The lower reach SF1 showed widespread impacts to riparian vegetation from agricultural activities. Approximately 50% of the total length ranked “poor” in terms of riparian condition. Eroding banks were associated with loss of riparian vegetation in several locations. Impairment to channel function did not appear to be severe in many instances, however.

Middle Fork of the Dearborn

The Middle Fork of the Dearborn is a steep, forested channel in the headwaters portion (reach MF2). Highway 200 and limited residential development are present along the riparian corridor. The Middle Fork showed minimal impacts to riparian vegetation and bank stability from human impacts in the upper reach MF2. No delivery of sediment from Highway 200 was apparent based on aerial reconnaissance and limited ground observation.

The lower reach of the Middle Fork (MF1) showed significant impacts to the riparian vegetation community. Approximately 65% of the riparian vegetation was ranked “poor” due to conversion of riparian vegetation to agricultural uses including grazing, pasture, and hay meadows. Bank stability and overall channel condition were sub-optimal; approximately 40-45% of the eroding banks were associated with human impacts.

Flat Creek

Flat Creek is a substantially altered system due to the diversion of irrigation water from the Dearborn mainstem. Sustained irrigation diversion and increased baseflow have resulted in impacts including enlarged channel cross section and probable channel downcutting. Flat Creek has adjusted to this altered flow regime to a large extent however eroding banks continue to contribute elevated sediment to the Dearborn mainstem. Grazing and conversion of riparian vegetation to pasture and agricultural use has significantly reduced woody species relative to site potential and contributed to sediment impairments. Almost no shade is provided by riparian overstory in most of Flat Creek except for the lower reach FC1.

Most of the increased sediment from eroding banks can be attributed to human impacts in Flat Creek. An estimated 80-90% of eroding banks in the “high” category were related to agricultural practices including increased flow, grazing, hay production, and cropping. Although woody species coverage increased from 1955-1995, riparian vegetation appeared to be sub-optimal relative to site potential.

4.2 Restoration Focus Areas

Dearborn Mainstem

The Dearborn mainstem had reaches with high channel instability (e.g. reach DR6), but these areas were related to natural channel process and do not appear to reflect existing or historical anthropogenic impacts. Evidence for this includes 1) the lack of human-related activity, 2) the lack of significant channel alterations, and 3) inherent instability related to geology and fluvial process. Therefore, no active restoration of riparian vegetation or channel planform/geometry is recommended for reaches of the Dearborn mainstem with the possible exception of reach DR3.

Reach DR3 was an unconfined Rosgen C4 type channel with channel instability in the upstream area. Conversion of riparian vegetation to hay/pasture has likely accelerated bank erosion in several areas. Recommended restoration activities include stabilization and revegetation of eroding banks with bioengineered geotextile treatments. Fencing and/or establishment of woody riparian buffer would help improve long-term stability.

Middle Fork of the Dearborn

No mitigation or restoration activities are recommended for the headwaters reach MF2 of the Middle Fork due to the relative lack of human impacts. Additional field investigation may be warranted to verify that no significant impacts from road sand occur on the Middle Fork.

Numerous areas of the lower reach of the Middle Fork have experienced some riparian impacts and channel instability mainly related to agricultural practices. Conversion of riparian corridors to pasture/agricultural uses has resulted in reduced riparian coverage. Approximately 4500 feet of channel showed a relatively high level of impacts to channel stability, and an additional 6600 feet had moderate impacts. Suggested restoration activities in the Middle Fork include improving woody riparian coverage and restoration of over-widened channel cross sections to reference conditions along impacted segments. Bank restoration can be accomplished with soft bioengineering methods (i.e. geotextile coir fabric wraps) and woody shrub/tree revegetation. Fencing or grazing rest-rotation in riparian areas would be beneficial to promote increased coverage of woody species. Offstream water sources may need to be developed.

South Fork of the Dearborn

The upper reach of the South Fork of the Dearborn is a steep, forested headwaters channel with minimal anthropogenic impacts. The headwaters are relatively undisturbed conifer forest in good condition and do not require any restoration or further assessment. The lower end of the upper reach (SF2) appears to have experienced some impacts from both logging/land clearing operations in the riparian area. Natural recovery from logging impacts would be expected to result in improving conditions in this reach. Some agricultural impacts (pasture/grazing/cropping) are present in reach SF2. Additional field assessment is recommended to determine if riparian clearing and agricultural impacts to the channel represent a significant impairment.

The lower reach SF1 experienced impacts from grazing and removal of riparian vegetation. Channel and riparian conditions were generally better than the lower reach of the Middle Fork. Additional field assessment in reach SF1 would be beneficial to establish whether any active

restoration is required. Suggested restoration activities in the South Fork include improving land use practices and possibly riparian fencing to promote riparian vegetation recovery.

Flat Creek

Riparian vegetation appears to have been significantly degraded due to livestock grazing (see discussion of FC2, FC3 and FC4 above), and to a lesser extent, 1964 flood effects. There are extensive portions of Flat Creek that are most likely impaired due to reduced channel shading and poor habitat as a result of degraded riparian vegetation.

The flow regime in Flat Creek is largely artificial. Restoration to pristine conditions is therefore not a realistic objective at this time. There are, however, steps that can be taken to reduce water quality impacts and improve habitat conditions while continuing to accommodate the current flow regime. Suggested restoration activities include promoting recovery or enhancing riparian vegetation, and reducing sediment impacts through restoration of eroding banks. Restoration activities in Flat Creek to address thermal impairment should seek to increase shading through enhancement of woody riparian components. Establishment of mature tree stands could be expected to provide significant shading to the channel, although it should be recognized that extensive Cottonwood riparian communities would not be expected to be typical of this edaphic setting. Willow shrub communities would be more typical, though shading provided by willow would be modest. Strategies to reduce sediment yield would include sloping and revegetation of unstable terraces/banks with geotextile/revegetation treatments.

APPENDIX E: RESPONSE TO PUBLIC COMMENTS

Response to Comments

As described in Section 6.0, the formal public comment period extended from November 19, 2004 to December 20, 2004 for the draft “Water Quality Assessment and TMDLs for the Dearborn River Planning Area”. Four individuals submitted formal written comments and one individual met with EPA in person to present comments verbally. Their comments have been summarized/paraphrased and organized by topic below. The original comment letters are located in the project files at DEQ and may be reviewed upon request.

Responses prepared by EPA and DEQ follow. Where specific modifications to the document have been made in response to comments, they are noted in the responses. Notable modifications between the draft and final versions of this document include:

- The introduction (i.e., Section 1.0) has been modified to include a description of the technical approach used in the Dearborn TPA.
- Section 6.0 (entitled “Proposed Monitoring Strategy for the Dearborn River” in the draft document) has been revised and is now entitled “Proposed Future Studies and Adaptive Management Strategy”. The revised section presents proposed future studies to address identified data gaps and/or uncertainties. A conceptual adaptive management strategy is also included in this section.
- A “Public Involvement” section (i.e., Section 7.0) has been added to the final document.
- A supplemental evaluation of the macroinvertebrate data collected in the mainstem Dearborn River, focusing on use of a Fine Sediment Index (Relyea, 2005), was conducted and is now included in Section 3.8.1. The results of this supplemental analysis are similar to the results from the previous analysis and, in general do not suggest fine sediment impairments in the mainstem Dearborn River.
- The analysis of temperature conditions in the Dearborn River was updated to include continuous (every 15-minute) data available for the period 1995 to 2004. These data did not add significantly to the temperature analysis that was reported in the draft document because they do not provide additional insight as to natural temperatures in the Dearborn River.

A. Temperature and Flow Issues

A1. Comment: The analysis regarding temperature pollution in the Dearborn River was inadequate and needs to be reevaluated.

Response: First, as stated in the draft document, we agree that the temperature analysis is inadequate and that further study is necessary. The question that needs to be answered is this: Is Montana’s temperature standard violated in the Dearborn River? Montana’s temperature standards were originally developed to address situations associated with point source discharges, making them somewhat awkward to apply when dealing with primarily nonpoint source issues, such as with the Dearborn River. For waters classified as B-1 (i.e., the Dearborn River), the maximum allowable increase over naturally occurring temperature (if the naturally occurring temperature is less than 67° Fahrenheit) is 1° (F) and the rate of change cannot exceed 2°F per hour. If the naturally occurring temperature is greater than 67° F, the maximum allowable increase is 0.5° F (ARM 17.30.623(e)). In practical terms, the temperature standards address a maximum allowable increase above “naturally occurring” temperatures to protect the existing temperature regime for fish and aquatic life. So, it is not possible to directly apply Montana’s temperature standard to the Dearborn River without knowing what the “naturally occurring”

temperature regime is in the Dearborn River. Since temperature data were not collected in the Dearborn River before it was impacted by human's actions, it will never be possible to know definitively what the "naturally occurring" temperature regime is for the Dearborn River.

We began the process by compiling all available temperature and flow data for the Dearborn River and tributaries and we also installed three continuous temperature recorders in the Dearborn River. We then sought similar data from streams that may be considered suitable reference streams for the Dearborn River (i.e., minimally impacted streams with similar hydrologic/geomorphic characteristics in similar settings). Streams that meet these characteristics would generally need to be along the Front Range and may include the Sun River, Teton River, Dupuyer Creek, Cut Bank Creek, Little Prickly Pear Creek and possibly others. Unfortunately, we were unable to locate a suitable reference stream that was not already significantly impacted by human activity and/or with sufficient data for comparison purposes. That left us with the modeling option that is articulated in Section 3.8.1.

We are well aware of the fact that there is a great deal of uncertainty associated with this approach. The results suggested a 1.2 °F increase in temperature associated with irrigation withdrawals. The model error was plus or minus 2.1 degrees. These results do not allow us to confidently answer the question: Is Montana's temperature standard violated in the Dearborn River? Therefore, we not only agree with the comment that *the analysis regarding temperature pollution in the Dearborn River was inadequate and needs to be reevaluated*, but we proposed additional study in Section 6.0 of the document to develop a better understanding of the potential temperature issues. Note that Section 6.0 of the document has been modified in response to public comment and DEQ/EPA have committed to a supplemental temperature study.

- A2. Comment:** This analysis did not consider all of the available temperature data. For example, FWP has spring through fall temperature data (recorded every half hour) from 1997 through 2004 near the Hwy 287 Bridge and the USGS collected data every 15 minutes through the period of record, and hourly readings (or better) are available through the USGS data archives (Steve Lynn, USGS, personal communications, 12/17/04). These data should be analyzed and reconsidered in regard to the TMDL for temperature.

Response: We were not aware of these additional temperature data. The FWP data were not mentioned during our conversation with Mr. Travis Horton (FWP) on June 24, 2004. In response to this comment, we contacted Mr. Horton and obtained the FWP temperature data. Temperature data were requested from USGS on April 7, 2004 and the only 15-minute data that were provided were for the period October 1, 2001 to June 16, 2003. These 15-minute temperature data are presented in Figure 3-10 of the public review draft report and were used during the analysis. In response to this comment, we contacted Steve Lynn on January 7, 2005 and obtained all of the available temperature data (which cover the period October 1, 1995 to September 30, 2004). These data were added to the final report but did not added significantly to the temperature analysis that was reported in the draft document because they do not provide additional insight as to natural temperatures in the Dearborn River. The data will be utilized in the proposed supplemental temperature study presented in Section 6.0 of the final document.

- A3. Comment:** The cumulative influence of riparian alterations in the basin (tributaries and mainstem) and their effect on water temperature throughout the basin should be evaluated.

Response: We agree and this is addressed in Section 6.0 of the final document.

- A4. Comment:** The narrative on page 13 of the draft document regarding the use of the head gate at the Flat Creek diversion is in error. The head gate is used on an as needed basis.

Response: Comment noted. The final document has been modified to address this comment.

B. Fish

- B1.** The following two comments suggested that the draft document did not adequately describe or consider the cold-water fishery. They also pointed out a potential relationship between temperature, nutrients, sediment and whirling disease. A single response is provided for these two similar comments.

B1a. Comment: The description of the cold-water fishery in the Dearborn River was not accurate. The Dearborn River is the main spawning and rearing tributary to the Blue Ribbon trout fishery in the Missouri River. Rainbow trout ascend the Dearborn River annually from March through May, spawn, and then return to the Missouri River. After hatching most rainbow trout rear for one winter in the Dearborn River basin before migrating to the Missouri River during spring runoff. Therefore, habitat and environmental conditions in the Dearborn River Basin set year class strengths for the rainbow trout population in the Missouri River. FWP has over 20 years of data relating to the production of trout in the Dearborn River, and impacts from low flows and high water temperatures are evident in these data. In addition, FWP has 5 years of data estimating the annual numbers of emigrating rainbow and brown trout.

B1b. Comment: The TMDL is thoroughly inadequate in how it describes the fishery of the Dearborn watershed. The description of connectedness with the Missouri River fishery is especially poor. For example, the agencies should have more rigorously reviewed - and consulted with FWP on - data used for estimating populations by age-class in the river. This includes correlating juvenile abundance (especially yearling fish) in the Missouri and the data on young of the year from screw trap capture in the Dearborn. These data can help determine how water years, temperature and possibly sediment transport affect annual production of Missouri River trout spawned in the Dearborn. We note that the Middle and South Forks, as well as Flat Creek, have populations of resident trout. There are very little data on these populations, so it's difficult to determine with any certainty whether the targets and threshold values in the TMDL are protective enough... Finally, there is no accounting in the TMDL for the relationship between temperature, nutrients and sediment to spore densities for whirling disease. Infection levels of whirling disease in fish in the middle and south forks are alarming, averaging a 4.9 in 2003 samples. A 4.9 is extremely hot, meaning there is essentially no recruitment in the sample population. Whirling disease occurrence is directly related to habitat conditions and temperature. It may be that the sediment targets, thresholds and supplemental indicators used for this TMDL are wholly inadequate for maintaining "increasing or stable" trends for coldwater fish populations.

Response: We have added a discussion of the Dearborn River fishery in Section 2.0 to enhance the description of the fishery provided in the final document.

Relative to whirling disease, it should be noted that this document focused on water quality standards compliance associated with discharges of pollutants (i.e., fine sediment and temperature). Montana's water quality standards for both sediment and temperature address allowable increases over "naturally occurring" levels. In general, if sediment and temperature levels are similar to "natural", including a consideration of all "reasonable land, soil, and water conservation practices" (ARM 17.30.602(21)), it is assumed that the water quality standards have

been met. At this point in time, neither the Montana Water Quality Act nor the federal Clean Water Act provide for more protection relative to the potential relationship between these two pollutants and whirling disease.

Finally, based on the available data, the Middle Fork Dearborn River, South Fork Dearborn River, and Flat Creek are considered impaired by fine sediment. Sediment load reductions have been proposed (Sections 5.1.1, 5.2.1, and 5.3.1), targets have been established (Section 5.4), and a phased conceptual restoration strategy has been proposed beginning with supplemental monitoring activities (Section 5.5 and 5.6). Implementation of this plan should result in reduced fine sediment levels. Therefore, to the extent that whirling disease is linked to fine sediment levels in these tributaries, whirling disease should also be addressed.

At this point in time, limited information is available on the relationship between whirling disease, temperature, fine sediments, and other habitat conditions. We are not aware of any studies, research, or literature that specifically correlate whirling disease with in-stream fine sediment levels in any measurable way. If future studies result in the establishment of such a correlation, TMDL targets can be modified if deemed appropriate, and in compliance with the State's water quality standards, at that time.

C. Fine Sediment/Pebble Counts

- C1. Comment:** At several points throughout the public review draft (e.g., p 79) statements were made concluding that excessive fine sediments were not impacting aquatic life or were not a significant impact to aquatic life. These statements are not supported by field data since not all types of aquatic life were investigated. Investigations on aquatic life were limited to algae and macroinvertebrates, and did not consider the various life-history stages of the many fish species. For example, fine sediments have been shown to cause suffocation of salmonid eggs in redds, or to prevent emergence of newly hatched fish. Increased nutrients, fine sediments, and organic materials may increase whirling disease infection levels in rainbow trout by creating more habitat for tubifex worms. Whirling disease has recently become a problem in the Dearborn River basin. Infection rates in the South Fork and the Middle Fork of the Dearborn are among the highest infection rates observed in Montana.

Response: Montana's 303(d) list addresses "aquatic life" and "cold-water fish" as two separate beneficial uses that must be supported. When we refer to aquatic life in the document, we are not referring to or including fish. We are well aware of the fact that fine sediments can affect the various life-history stages of many fish species. All of the targets and supplemental indicators presented in Table 3-4 have either a direct or indirect link to support of both the "aquatic life" and "cold-water fish" beneficial uses.

- C2.** The following four comments all pertain to the use of pebble count data and, therefore, are addressed together. Combined, the comments suggested that:

- Too much reliance was placed on the use of the pebble count data
- The pebble count data may or may not be spatially or temporally representative
- No discussion of statistical certainty was provided.

C2a. Comment: Reliance on pebble count data without any discussion of data quality objectives associated with these measures is not in accordance with EPA's guidance on data quality objectives. Pebble counts are a biased measure, particularly in estimating the finer

gradations. In addition, this is most commonly used as a geomorphic measure. Studies applying this method to evaluate fine sediment stress typically train field observers to avoid the larger particle bias. There was no mention of training to reduce this type of bias. In addition, the document contains no discussion of the precision, accuracy, or representativeness of substrate conditions along the length of the Dearborn River.

C2b. Comment: The only nominally valid data related to sediment we found are from Wolman pebble counts. However, pebble counts are inherently biased towards the larger fractions in sediment. It is unclear whether the agencies reviewed whether bias occurred because the TMDL does not include a Quality Assurance Plan addressing precision, accuracy and representativeness in the data. We note that even if the quality of the pebble counts meets standards, too few were done in too few places to provide a statistically valid representation of substrate conditions in the Dearborn River and its main tributaries. Basically, the agencies have taken limited data and stretched it to make sweeping conclusions about long reaches of stream.

C2c. Comment: The EPA reports the results of five pebble counts for the entire river without addressing the representativeness of this sampling scheme. Do these few sampling sites adequately describe substrate composition for the entire Dearborn?

C2d. Comment: Statistical certainty is another technical aspect of natural resource planning that is left out of this TMDL document. The pebble count data are an example of this; the EPA removes siltation as a pollutant largely based on data without determining whether pebble counts reflected the “real” substrate composition in the river. It is not scientifically credible to make these decisions without replicating samples and performing statistics.

Response: Since Montana’s water quality standards for sediment are narrative; there is no single parameter that can be applied alone to provide a direct measure of beneficial use impairment associated with sediment. The weight of evidence approach described in Section 3.3 of the document is predicated upon this fact. The surface fines target (using pebble count data) was selected specifically to provide one measure of potential sediment impairment associated with the aquatic life and cold-water fisheries beneficial use. Pebble counts were developed and have been regularly used by state and federal agencies to ascertain the amount of surface fines affecting streams (CDPHE 2002, EPA TMDL Sediment Guidance Year 1999). Furthermore, as stated in Section 3.4.1, “*Recent work completed in the Boise National Forest in Idaho show a strong correlation between the health of macroinvertebrate communities and percent surface fines...*” The information provided by pebble counts were used in combination with the information provided by all of the other targets and supplemental indicators to reach conclusions about water quality impairment.

It should further be recognized that the highest observed percentile for fine sediment (<2mm) was 11 percent at the most downstream station in the watershed. This value was well below the proposed target of 20 percent. The remaining fine sediment values ranged from 4.9 to 6.5 percent in the upstream reaches. Despite the small sample size in the Dearborn mainstem, we feel that the statistical likelihood of a substantial number of observations approaching or exceeding the 20 percent fine sediment threshold is low.

The following QAPP was used to guide all data collection activities in the Dearborn River and several other Montana watersheds during the 2003 field season:

Tetra Tech, Inc. 2003. *Data Collection for Physical, Chemical, and Biological Characterizations of the Montana TMDL Planning Areas (TPAs)*. Prepared for the U.S. Environmental Protection Agency. June 23, 2003.

This QAPP addresses the issues of methods, precision, accuracy, and representativeness. Furthermore, the personnel who conducted the pebble count analysis were trained individuals with extensive field experience who understood how the data were to be used and the importance of collecting unbiased results.

- C3. Comment:** Do these pebble counts reflect substrate composition in trout spawning areas?

Response: Pebble counts were not intended to reflect substrate conditions in spawning areas. The pebble counts were designed to reflect substrate condition where the biological samples (i.e., macroinvertebrates) were collected. Pebble count data, when used in combination with macroinvertebrate data, are thought to provide insight into overall watershed health relative to sediment. Thus, while substrate conditions in trout spawning habitat were not specifically measured, it is felt that the methods employed herein, provided a watershed scale perspective regarding potential fine sediment impairments.

- C4. Comment:** The pebble count data also ignore the important issue of seasonality. Pebble count data were collected at various times; however, the authors do not attempt to evaluate substrate composition in critical periods. The Dearborn River is an important spawning area for the Missouri River fishery, yet there are no data to evaluate substrate characteristics during spawning and incubation of either spring or fall spawning fishes. Pebble counts performed after spring runoff will miss conditions present during spring spawning and will also reflect the effect of scouring during high flows. Addressing seasonality will greatly strengthen determinations associated with siltation as a pollutant of concern.

Response: We acknowledge that seasonality in pebble count data may exist to some extent. However, we feel that the existing data indicate that fine sediment (<2mm) is unlikely to exceed the target of 20 percent regardless of season (see response in C2d above). Given pragmatic sampling considerations during elevated spring run-off, Wolman pebble counts were designed to be conducted during baseflow periods. Baseflow periods represent low stream power conditions and potentially the maximum accumulation of fine sediment. Pebble counts taken during elevated flow conditions would likely result in similar or lower fine sediment results. Additionally, sampling during baseflow reduces year-to-year variability because the observations are made during the same timeframe.

D. Aerial Survey

- D1.** The following two comments suggested that too much reliance was placed on the results of the aerial survey and field verification should have been conducted. A single response for both comments is provided.

D1a. Comment: The document over extends the appropriate use of the aerial photo analysis. Similar to other types of information used in this report, there is no discussion of data quality objectives. In other watersheds, assessments of aerial imagery are treated appropriately as a coarse screen that guides field sampling. It is simply not credible to use aerial photo analyses without validating the results on the ground. Detecting eroding banks from aerial photos is easier

when observing lateral bank migration, and much of the Dearborn is laterally confined; thus, this type of methodology would underestimate bank erosion.

D1b. Comment: In our opinion, the EPA overextends the aerial photo survey in this TMDL plan. The proper role of an aerial survey is an initial investigation to guide further studies. In other words, it is an initial screen, not an end in itself. The EPA uses this aerial survey without conducting a field assessment to verify results. Field verification is especially important when addressing sediment loading from eroding banks. Many eroding banks may not be visible from aerial photos. Moreover, the use of lateral channel migration as an indication of eroding banks may not work in a laterally confined system like the Dearborn River. Without field verification, we have serious concerns about applying the results of the aerial survey effort to decisions regarding sediment loading and riparian function. We encourage the EPA to conduct the necessary field assessments to resolve this deficiency.

Response: The basis for our technical approach is described in Section 1.1 of the final document. This project relied on the results of the aerial photo analysis because (1) historical photos were available from 1955, 1964, and 1995 to assess trends and the impacts of the 1964 flood, (2) the low-level (4500 feet) survey conducted in 2003 provided source assessment information on the entire watershed, and (3) limited access across private property precluded the collection of watershed-scale data via any other means. Private lands comprise 71 percent of the watershed and total approximately 390 square miles.

The results of the aerial photo analysis generally matched observations made on the ground. For example, on-the-ground Bank Erodibility Hazard Index (BEHI) surveys were conducted at two sites on Flat Creek during the summer of 2003 and generally matched the findings of the aerial assessment report. Visual assessments made during sampling also were consistent with the findings of the aerial assessment report. Also, for the Middle and South Forks, private and/or public roads parallel the streams for much of their length. Field crews drove or walked much of these watersheds conducting visual surveys with the intent of verifying observations made from the air. Finally, EPA and DEQ floated the reach of the Dearborn River from Highway 287 downstream to the confluence with the Missouri River in 2002.

D2. Comment: Riparian measures consisted entirely of qualitative evaluations during the aerial photo assessments and a qualitative questionnaire with very low spatial coverage. As with other data presented in this document, there is no discussion of data quality objectives for these data. Qualitative questionnaires have high interobserver bias, and thus may not be reliable when eliminating probable causes of impairment.

Response: Data quality objectives are discussed in the QAPP. Data regarding riparian condition (i.e. coverage, presence/absence, large scale modifications) was used only in the context of the supplemental indicators. As described in Section 3.3, the supplemental indicators were not considered sufficiently reliable to be used alone as a measure of impairment. “Riparian Condition”, and all of the supplemental indicators were only used when one or more of the target threshold values were exceeded to provide supporting and/or collaborative information when used in context with all of the other available data.

Three individuals familiar with the Dearborn Watershed worked collaboratively to assess and review riparian assessments made from aerial photos. All staff recognized the inherent limitations of a remote sensing method to draw any detailed conclusions about riparian health. However, it should be recognized that extremes in riparian coverage and function (e.g. wide,

extensive riparian corridor versus total riparian removal) can be reliably evaluated from aerial photos. This “screening level” of analysis was considered appropriate to identify potential major impacts.

- D3.** The following two comments suggested that ground-truthing should have been completed to verify the result of the aerial surveys. A single response is provided below.

D3a. Comment: The aerial evaluation of riparian health and channel stability is fine for a coarse filter review. However, few conclusions can be made from this sort of examination without validating conditions on the ground. The agencies should have tested conclusions made from the aerial reviews with fieldwork, perhaps using vegetative transects, channel transects, or even at least a Pfankuch type evaluation. We note that the consultant's report is riddled with expressions like “appeared to”, “did not appear to”, etc. Therefore it's clear even the consultants are unsure about making firm conclusions from their reviews of two sets of aerial imagery and last year's over flight. Without a description of the quality assurance expected from these qualitative “data”, the conclusions are highly suspect. For instance, we note that it can sometimes be difficult to make any conclusions of eroding banks from the air, especially in confined channel types, which is the case of the Dearborn on much of its length. We also note that evaluating riparian health from the air can be tricky without an on-the-ground perspective. For example, it appears the aerial evaluations were made from inspections during dry years or seasons when bank saturation - a condition that can trigger instability - wasn't present.

D3b. Comment: On-the-ground bank stability surveys should have been used to verify conclusions made about bank stability from aerial photographs.

Response: On-the-ground Bank Erodibility Hazard Index (BEHI) surveys were conducted at two sites on Flat Creek during the summer of 2003 and generally matched the findings of the aerial assessment report. Visual assessments made during sampling also were consistent with the findings of the aerial assessment report. Also, for the Middle and South Forks, private and/or public roads parallel the streams for much of their length. Field crews drove or walked much of these watersheds conducting visual surveys with the intent of verifying observations made from the air. Finally, EPA and DEQ floated the reach of the Dearborn River from Highway 287 downstream to the confluence with the Missouri River in 2002.

- D4. Comment:** Criteria used to classify sediment sources as “natural” or human caused in the aerial survey were not apparent.

Response: The aerial survey relied upon fixed wing aerial reconnaissance, and review of historic aerial photos. The primary human activity potentially influencing sediment sources is related to agricultural land use in the watershed. Sediment sources were classified as “human caused” primarily based on the extent of riparian vegetation removal and apparent impacts on channel stability associated with riparian alterations. Adjacent stream reaches with intact or greater riparian coverage provided a basis for comparison and interpretation of potentially impacted reaches. Another human cause for sediment source specific to Flat Creek is channel enlargement and eroding banks related to irrigation flow augmentation. Sediment sources within Flat Creek were generally attributed to human cause due to this flow alteration. Natural sediment sources were considered to be those areas not clearly associated with riparian modification or intensive agricultural land uses. Eroding landscape features such as terraces/hillsides were included in the natural sources category.

This approach provided a qualitative, screening level method of identifying potential human caused sediment sources. We agree that not all potentially human caused erosion or sediment sources would be identified using this approach. For example, intense grazing within riparian areas may result in channel modifications or localized erosion that might not be identified unless visible channel instability resulted. Potential sources within confined channels were also difficult to assess using this approach.

E. Habitat/Riparian Condition

- E1.** The following two comments suggested that anthropogenic impacts can exacerbate the effects of naturally occurring disturbances. A single response is provided below.

E1a. Comment: Some habitat degradation due primarily to naturally occurring disturbances (the 1964 flood and forest fires) in the Dearborn River basin were discounted as not being influenced by human activity; however, there was and is an anthropogenic effect both before and after such events that must be considered (e.g., land use activities in the Dearborn River basin may have exacerbated the effect of the 1964 flood).

E1b. Comment: Although we agree that naturally occurring events (floods, forest fire, etc) have an impact on the form and function of lotic systems, we believe that anthropogenic impacts exacerbate the effects of these events. The anthropogenic influences can include more destructive fires (due to years of fire suppression and build up of fuels), less stable riverbanks due to land management activities, etc. Inferring that the events were natural and their damage unpreventable discounts the anthropogenic influences. Finally, we propose that many of the habitat survey results could have been influenced by the long-term drought in the Dearborn River basin, and suggest some discussion on these potential influences.

Response: We agree that the effects of naturally occurring disturbances might have been exacerbated by anthropogenic activities. This may be especially relevant in unconfined channel types where riparian vegetation plays an important role in stable channel morphology. However, quantifying the extent to which this might have occurred in the Dearborn River is very difficult. The decision that anthropogenic activities were not, in general, a significant factor is due in part to the fact that the vast majority of the watershed is relatively undisturbed. For example, the available land use data suggest that anthropogenic land uses (i.e., pasture/hay, small grains, commercial/industrial, fallow, row crops, and low intensity residential) account for less than 4 percent of the total watershed area. Furthermore, some anthropogenic activities fall within the definition of “natural conditions” per the provisions of 75-5-306 MCA (i.e., Natural refers to *“conditions or materials present in the runoff or percolation over which man has no control or from developed land where all reasonable land, soil and water conservation practices have been employed.”*)

- E2. Comment:** The cumulative habitat degradation impacts in the tributaries (increased sediment, decreased flow, increased temperature, etc) should be evaluated on the mainstem Dearborn River. In other words, the habitat impacts in tributaries are causing habitat problems in the mainstem river.

Response: There is no indication based on the available data that that habitat degradation in the tributaries is currently causing problems associated with sediment in the mainstem Dearborn River. The Dearborn has percent fine sediment values well below threshold target values.

However, we do agree that habitat alterations may have an affect on downstream water temperatures. This has been addressed in the final document in Section 6.0.

- E3. Comment:** It is unclear why the NRCS habitat survey was only conducted in the lower reach of the Flat Creek drainage. We argue that this area is not representative of habitat conditions in the upstream reach. If more sites cannot be inventoried in the upper basin, the results from the one reach downstream should not be considered as part of the analyses.

Response: Habitat surveys were conducted at two additional sites along Flat Creek (including one farther upstream) but were mistakenly left out of the draft report. In addition, the reported score for the site below Birdtail Road was wrong. The corrected scores appear in the final report and suggest that habitat is at risk below Birdtail Road and at Milford and sustainable at the mouth.

We agree that the habitat in the lower reach of Flat Creek is not representative of conditions upstream. However, the aerial survey we conducted allowed us to view and assess (at least at the “coarse” level) habitat conditions along the entirety of Flat Creek. Further, collecting additional field data upstream (where conditions are poorer) would not have resulted in a different conclusion regarding impairment status (i.e., Flat Creek would still be considered impaired and a sediment TMDL would be deemed necessary).

- E4.** The following two comments questioned the methods for sample site selection and suggested that the results of the riparian surveys were averaged across major ecotones. A single response is provided below.

E4a. Comment: It was not clear how sites were selected for habitat monitoring throughout the planning area. In the tributaries, the results from surveys were averaged across major ecotones. Had the results been considered excluding the headwater forested areas of the Middle and South Fork the conclusions may have been different.

E4b. Comment: Conclusions on riparian health seem to have been averaged across eco-types. This misrepresents conditions on the ground. For instance, we note that when looking at the South Fork of the Dearborn, the agencies combine the more stable channel conditions from forested uplands on public land with those found on the heavily damaged pasture sites on private land. Averaging them together, it's easier to conclude the South Fork is in decent shape. However, by bracketing the evaluations by shorter stream reaches and by eco-type and channel type, the conclusions will be different. We note that data seems to be used selectively. For example, the agencies make conclusions about Flat Creek's stability based on an NRCS cross-section located where the channel is naturally confined. This is misleading. There should also be corresponding data upstream or downstream in meandering meadow reaches.

Response: Sampling locations were selected to represent upstream, downstream, and transitional reaches of the subject streams. Sites were chosen based on the presence of historic sampling locations, changes in land use or landform, and the confluence with tributaries.

The location of the sampling sites was taken into consideration during the analysis and conclusions were not made based on averaging the values. For example, the impairment summary for the Middle Fork (page 82) states: *“When averaged, the targets are all met and do not indicate water quality impairment associated with sediment. However, examination of the results from some of the individual samples suggests potential localized areas of minor sediment*

related impairments.” We disagree that the conclusions might have been different if we had bracketed the evaluations by eco-type, channel-type, etc. We still think the conclusion would have been that the Middle Fork, South Fork, and Flat Creek are impaired and that sediment TMDLs are necessary.

- E5. Comment:** My family has lived in the Flat Creek drainage since the late 1800’s. Historically, there were never willows along Flat Creek.

Response: We recognize that willow and other shrub communities can be quite variable and reflect a combination of site characteristics (geology, soils, hydrology, etc), climate, land use, and other factors. Flow in Flat Creek is enhanced due to irrigation diversion, which may also alter willow establishment and survival. Other potential factors include historical grazing (pre-settlement bison, post-settlement sheep, etc). The relative impact of these influences is difficult to quantify. Flat Creek does currently support a variable coverage of willows and other riparian species. We would agree that willow coverage was potentially different at the turn of the century than the present day.

F. Methods

- F1.** The following three comments suggested that EPA and DEQ should have developed a QAPP and SAP. A single response is provided below.

F1a. Comment: The development of this TMDL document did not follow the typical pattern and method used on past TMDLs developed in Montana. In the past cases, a logical, orderly approach was employed where an initial, phase 1 assessment involved compilation and synthesis of available data, identification of data gaps, and development of quality assurance project plan (QAPP). The lack of the QAPP sets the stage for a technically poor plan that over extends the use of low-quality data. Field investigations directly related to the Dearborn River TMDL plan were negligible and apparently not guided by a QAPP or sampling and analysis plan (SAP), both of which are EPA requirements.

F1b. Comment: It appears the agencies did not attempt to fill data gaps with new information. Instead, it appears the available data--most of vague quality--were made to fit into pre-determined conclusions about watershed health, water quality and pollutant allocation.

F1c. Comment: Nowhere in the document did we find a methodical description of all available data that were reviewed. Nor did we find a description of data gaps, or the Quality Assurance Plan DEQ/EPA employed when both agencies apparently agreed the limited data used were valid. The result has been a hodge podge description of data reviewed. Moreover, it is difficult to determine whether any of the data used meets EPA’s quality assurance quality control requirements.

Response: The development of the Dearborn River TMDL did in fact follow the pattern described in this comment. Available data were first compiled and analyzed, data gaps were identified, a Sampling and Analysis Plan was prepared, a quality assurance project plan (QAPP) was prepared, and additional data were collected. The field sampling that occurred in summer 2003 and the low-level aerial survey were both intended to fill identified data gaps. A description of all of the data that were reviewed appears throughout Section 3.0 of the document and raw data are available in Appendix B.

The following QAPP was used to guide data collection activities in the Dearborn River and several other Montana watersheds during the 2003 field season:

Tetra Tech, Inc. 2003. *Data Collection for Physical, Chemical, and Biological Characterizations of the Montana TMDL Planning Areas (TPAs)*. Prepared for the U.S. Environmental Protection Agency. June 23, 2003.

The SAP and QAPP are both available for public review (the QAPP document is 439 pages long) upon request.

- F2. Comment:** It appears that in preparing this plan, the EPA was more concerned with administrative outcomes, namely meeting strict time demands. Although we do understand time constraints, the focus should be on producing a technically sound plan that truly restores and protects aquatic resources in the Dearborn River watershed. With a reprieve in the TMDL deadlines, we hope that the EPA shifts priorities to improving water quality and restoring fisheries, rather than solely meeting administrative goals

Response: DEQ and EPA selected the Dearborn TPA as a pilot project to evaluate the feasibility of completion of all necessary TMDLs relying primarily on currently available data, use of remote sensing techniques, and application of modeling techniques. This approach is described in Section 1.1 of the final document. The Dearborn TPA was selected for this approach because, with the exception of the headwaters region, the Dearborn TPA is largely under private ownership with limited access. Also, when this approach was originally conceived in July of 2002, all necessary TMDLs for the Dearborn TPA were scheduled for completion by December 31, 2003. We disagree that the Dearborn analysis was technically insufficient. Qualified technical experts assessed available and newly collected data that met defined data quality objectives and appropriately applied the TMDL regulations to the information. We do agree, however, that data gaps exist, such as the remaining question of temperature impairment on the mainstem of the Dearborn, and that data uncertainty is too high to make a final decision regarding temperature impairment. Therefore, as noted in our response to comment #A1, we have outlined follow-up studies to better support final decision making.

- F3. Comment:** Another concern regarding EPA's approach and lack of technical standards relates to the other watersheds assigned to EPA for TMDL development. This plan does not compare favorably to other TMDLs in terms of technical merit and public involvement. Unless the EPA follows its own guidelines for watershed monitoring and planning, TMDLs developed by the EPA will be less likely to protect and restore our waters. The technical insufficiencies of the Dearborn TMDL also have ramifications for the quality of plans approved by the EPA. The EPA is responsible for approval of TMDLs. Our concern is that if the EPA produces substandard TMDLs, they will likewise approve substandard TMDLs.

Response: EPA and MDEQ have established a joint approach to development of TMDLs/Watershed Restoration Planning in Montana. By standardizing the steps, from assessment of all currently available data, determination of data gaps, following the MDEQ approved Quality Assurance Project Plans for sampling and analysis, consistent use of laboratories, application of defensible analytical tools, confirmation of impairment status, identification of pollutant sources, setting of targets, allocation of loads, forthright presentation of data uncertainty, proposed follow up actions and internal/external peer and public review, both agencies are attempting to meet a level of technical rigor that is scientifically defensible given the

constraints of time and the state of the science. The Dearborn TPA process followed this standardized protocol.

Although EPA and MDEQ have established a consistent approach, each case will dictate a slightly different application based on the unique circumstances within the watershed. As described in our response to Comment F2, the Dearborn TPA is largely under private ownership with limited access. These unique features are the reason DEQ and EPA selected the Dearborn TPA as a pilot project to evaluate the feasibility of completion of all necessary TMDLs relying primarily on currently available data, use of remote sensing techniques, and application of modeling techniques. Based on the results, we feel that this approach was adequate for the tributaries (Middle Fork, South Fork, and Flat Creek) and the siltation listing on the mainstem of the Dearborn River. However, the level of certainty associated with this approach was inadequate regarding the temperature analysis in the mainstem Dearborn River. The document acknowledges the uncertainty associated with the temperature analysis and EPA and DEQ have committed to the completion of a supplemental flow and temperature study in Section 6.0.

G. Public Notice and Document Availability

- G1. Comment:** We have concerns regarding the level of public involvement incorporated in this process. Specifically, it appears that the EPA did not follow the example of other watersheds in Montana, where a local watershed group, local fisheries managers, conservation groups, landowners, and other stakeholders or interested parties were part of the process. The lack of stakeholder participation is a considerable concern in getting landowners to accept and implement plans. Also, failure to include local natural resource professionals results in a document that does not reflect an informed understanding of the river's fisheries. We strongly recommend that the EPA include more stakeholders to produce a TMDL document that incorporates the knowledge of individuals working and living in the watershed.

Response: Due to the lack of a formal, organized watershed stakeholder group in the Dearborn TPA, public involvement was generally limited to the elements required by the Montana Water Quality Act. The Lewis & Clark Conservation District was notified during the initial stages of project development and kept apprised of activities/progress throughout the project. The Conservation District was also partially relied upon to assist in obtaining landowner contact information to gain access for field activities. The Sampling and Analysis Plan prepared to direct field-sampling activities was provided to the Lewis & Clark Conservation District and landowners who provided access for sampling (if they were interested in having a copy) prior to initiation of field activities. Additionally, contacts were made with the Montana Department of Natural Resources, Montana Fish, Wildlife and Parks, U.S. Natural Resource Conservation Service, and USGS to request all available data as well as any information that they may have had regarding local activities.

Further opportunities provided to the public regarding review of the draft document are described in Comment G2 below.

- G2. Comment:** Not providing public notice to organizations such as ours who have long demonstrated an interest in water quality and watershed health. We learned about the impending release the recent spate of draft TMDLs only through a reporter, right before the comment deadline for the Flathead Headwaters TMDL. Thus we couldn't plan appropriately for the type of review we like to do, which includes consultation with additional professionals.

Response: The draft Water Quality Assessment and TMDLs for the Dearborn River Planning Area document was formally released for public review on November 19, 2004. The notice of availability was made through a press release to the following media sources: Cascade Courier, Great Falls Tribune, High Plains Warrior, KEIN-AM/KLFM - FM, Rural Montana, KTVH-TV, KBLL-AM, KFBB-TV, KMTF-TV, KXGF, KMON-AM, KRTV, KTGF- TV, the Helena Independent Record, the Queen City News, and the Associated Press. It was also posted on “Newslinks” which is a subscriber service for all media, and the notice and draft document were posted on DEQ’s website. We also made phone contact, and visited, with the Lewis and Clark Conservation District and NRCS to alert them that the document was available for review, provide them with copies of the draft document, and request their assistance in notifying their constituents within the Dearborn River Watershed. Additionally, we made phone contact with all of the landowners within the watershed, that we previously made contact with to obtain permission for sampling, to alert them of the document availability.

We regret that your organization was not specifically notified, but feel that adequate public notice was, in fact, provided. DEQ is currently in the process of developing an improved TMDL public notification/information program. In the future, we hope to ensure that all interested parties are provided adequate notification.

- G3. Comment:** A final consideration directed primarily at DEQ relates to the timing of releasing TMDLs for public review. This year, the DEQ bombarded the public with plans at the year’s end. The number of plans released so close in time presents a hardship to parties interested in more than one watershed. We suggest that DEQ stagger the release of these documents so as not to shortchange the public participation process. Once again the reprieve in the deadline should allow DEQ/EPA more flexibility in planning the release of these plans.

Response: The courts and our constituents have been asking for DEQ and EPA to increase the pace of TMDL development since the program officially began in Montana in the late 1990’s. The pace of TMDL development in Montana has increased annually since the year 2000 and is expected to continue to increase. This, inevitably, will result in an increased burden on the public to review more and more TMDL documents on an annual basis.

To date, the timing of the release of public review drafts has largely been driven by a rigorous, court-imposed schedule with annual milestones. Given a court-imposed schedule, Montana’s TMDL Program has operated on a calendar year basis since the year 2000, with TMDL documents scheduled for completion by the end of December every year. This has resulted in the release of most of the public review drafts in October, November, or December on an annual basis.

Nonetheless, DEQ appreciates the challenges the public may face when multiple draft documents are published at the same time. DEQ is working to address numerous issues including:

- developing standard procedures for notification of document availability,
- pre-specifying convenient locations for the public to review the drafts (such as local libraries),
- standardizing text viewing software for review of the documents electronically, and
- creating a streamlined process for receiving and recording public comment.

It is also important to note that DEQ is strategizing on ways to better inform the public on upcoming public draft releases so that the public can prepare and schedule appropriately with the timing of the release of each draft document.

Further, although many public review draft TMDL documents will continue to be released in the last three months of the year, some future modifications to the release of TMDL documents are planned. For example, a phased approach will be taken for some of the larger and more complex TMDL Planning Areas, where the required TMDL elements will be presented in a series of “volumes”. The first volume for a given TMDL Planning Area may contain the first two sections or chapters of the typical TMDL document (i.e., Watershed Characterization and water quality Impairment Status). The remaining sections of the typical TMDL document (i.e., source assessment, total maximum daily loads, targets, allocations, margin of safety, etc.) will be presented in subsequent volumes, as appropriate based on the scale and complexity of the TMDL Planning Area. In 2005, it is envisioned that the first “volumes” (i.e., Volume I) of several TMDL documents will be released during the first half of the year. Subsequent volumes will then be made available to the public when they are completed. This will provide the public with more time to review DEQ’s more complex TMDL documents and will ensure that the entire public review time period is spread out throughout the year, rather than waiting for the last three months of the year.

Additionally, some TMDL documents are scheduled for completion throughout 2005. These will be made available for public review as soon as they are completed, thus avoiding the last three months of the year.

- G4. Comment:** When we examined the Dearborn TMDL on the website last week, we found not all the pages were available. Thinking it could be a problem with our version of Acrobat Reader, we double-checked with several other TMDLs on the DEQ site. We had no problem reading those, leading us to conclude that perhaps the problem was with DEQ. After several hours of investigation, including calls to DEQ, we finally found an administrative staffer at the agency that helped us understand the problem; not all the TMDL documents on DEQ’s site were done using the same version of Acrobat, but the agency hadn’t bothered to tell the public. Thus, though technically the problem was on our end, DEQ could have facilitated things and saved time for reviewers by simply noting on its website that the public needs different versions of Acrobat Reader for reviewing different TMDLs.

Response: In an effort to produce documents that are easy for the average person to read and understand, we often include large numbers of graphics and photographs. This results in large electronic files that are often difficult to download. In the future, we will ensure that all downloadable document files are small enough for the average person with a “home computer” to download and will also improve our website to make all necessary directions for downloading more obvious.

H. Miscellaneous Topics

- H1. Comment:** I believe that “the fires in 1989” caused the biggest sediment problems in the Dearborn drainage. I observed turbid flows in the Flat Creek diversion for at least a couple of years after the fire. Ice scour during spring floods has caused many of the bank erosion problems.

Response: We agree that the 1989 fires and ice scour have contributed to the current sediment problem in the Dearborn drainage. Table 2-6 of the report indicates that approximately 7 percent

of the watershed (primarily in the headwaters) consists of “standing burnt forest”. However, we believe that there are also localized problems caused by human activities, especially in Flat Creek.

H2. Comment: This study was conducted during a period of drought that has occurred for at least the last 5 years.

Response: We agree that the current drought conditions have likely biased some of the observed problems and attempted to address this by evaluating the 1955, 1964, and 1995 aerial photographs. Future study of the Dearborn River drainage is recommended once the current drought ends.